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NEW POWER PLANT OF THE PACIFIC MILLS

By WALTER B. SNOW

WITH the natural increase in the size of the plant, the increase in machinery speeds requiring additional power and the ever increasing demand for steam for manufacturing purposes, the reorganization of the entire plant of the Pacific Mills, Lawrence, Mass., became necessary.

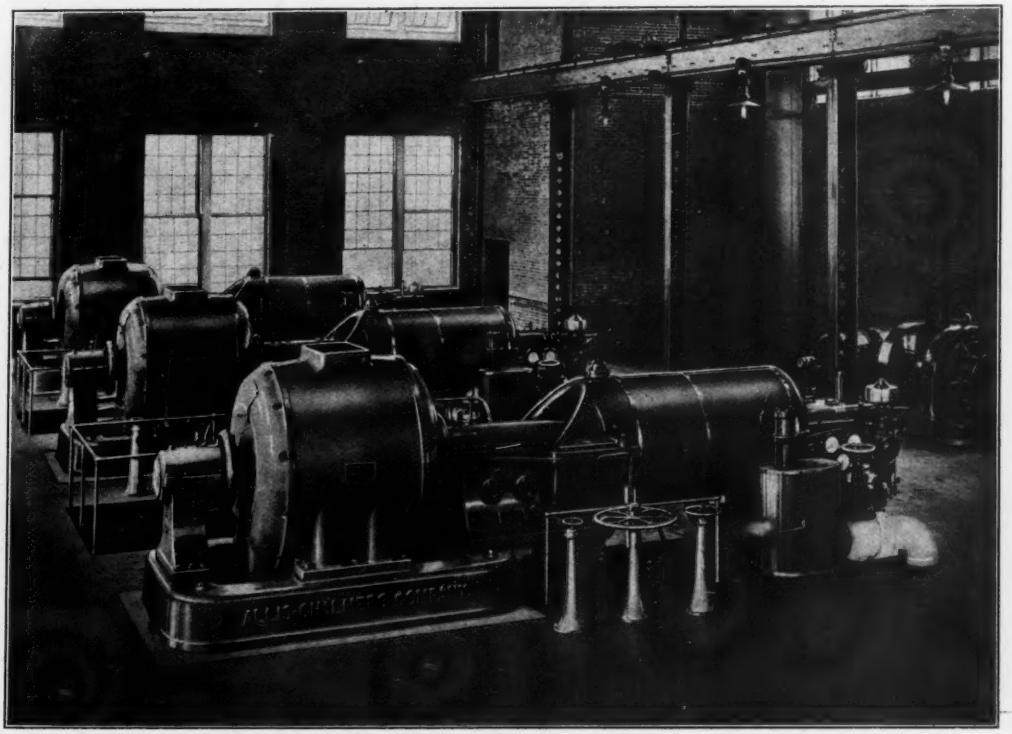


FIG. I. VIEW OF ALLIS-CHALMERS TURBINE-GENERATING UNITS IN PACIFIC MILLS PLANT

The new power plant designed by Charles T. Main, mill engineer and architect, of Boston, is the beginning of this reorganization on a comprehensive basis. Some idea of the magnitude of this plant and the power necessary to run it may be formed when it is considered that there is a cotton department with 180,000 spindles and 6717 looms, a worsted department of 53,064 worsted spindles and 2650 looms, and a print works with 27 printing machines. Heretofore energy has been supplied from several sets of water wheels, independent boiler plants, and engines located in various departments. The new station consists of a coal pocket close to the steam railroad tracks, a boiler room and turbine-generator room, arranged in

the progressive order named. The present machinery equipment is for 3000 electrical horsepower, with building space to accommodate a large increase.

terra cotta trimmings, with concrete roof and floors. The entire framing is of steel, including floor beams and roof trusses. The boiler room floor is on the

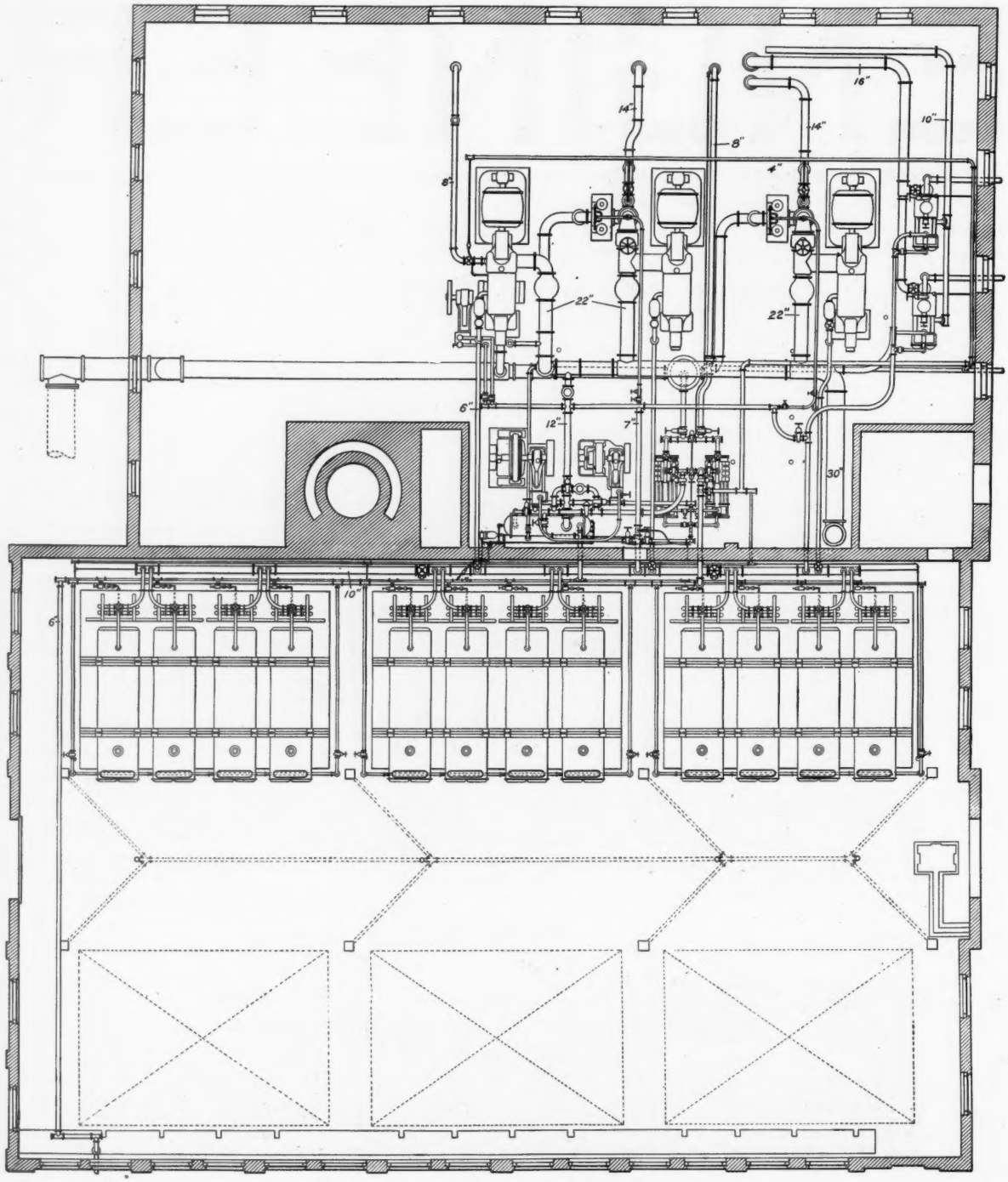


FIG. 2. PLAN OF PACIFIC MILLS PLANT

The Building

The main building, comprising turbine generator room, 78 ft. 6 in. by 125 ft. 5 in., and a boiler room 86 ft. 8 in. by 142 ft., is built of brick with granite and

same level as the turbine room basement and the yard outside.

The boiler room, of one story, has two rows of columns spaced on 17-ft. bays, the area between them

being used as a firing floor, the boilers occupying the space between the columns and walls. The roof is covered by a metal frame skylight between the 2 rows of columns, the eaves of which are high enough above the main roof to accommodate a row of metal ventilating louvres, which can be operated from the boiler room floor. The roof of both the turbine and boiler rooms is composed of reinforced cinder concrete covered with plastic slate. The chimney is 200 ft. high and 9 ft. diameter inside the core, the latter extending the entire height of the chimney. The core and the shell, both of red brick, are covered with a cast-iron cap made so that the core is perfectly free to expand.

Coal Pocket

The coal pocket is 209 ft. 6 in. by 52 ft. by 20 ft. deep from the trestle from which the coal is dumped, the floor lying 10 ft. below that of the yard level. The retaining walls are of reinforced concrete, while above them the plain walls are of cement plaster and expanded metal and steel framing. The roof is of wood covered with slate, supported by steel trusses and steel columns between walls. Lighting is accomplished by skylights in the roof and ventilated by louvres in the side walls and a monitor in the roof. Outside, the trestle is of wood, while inside the pocket the dump cars are carried on steel bents.

Turbine Room

The turbine room, 25 ft. high under roof trusses, affords a well lighted easily ventilated power room. The floor, of reinforced concrete supported on steel beams 14 ft. above the boiler room floor and ground level, provides a basement containing the auxiliaries and other equipment. In the space between the two rows of columns spaced 44 ft. centers on 17-ft. bays, are located the main units. To avoid any possibility of transmitting vibration from the machinery to the building the turbine foundations and floor are built entirely separate. Between the east columns and wall are the small engine units and exciters, while between the west row of columns and the corresponding wall is found the switchboard. The main generator space is covered by a 15-ton crane made by the Reading Crane and Hoist Works, and the space for the exciters by a 5-ton crane, both being hand operated. A stair tower at one end of the turbine room leads to a fireproof storeroom. Two toilet rooms with showers for the use of the men are situated on the main floor and the basement.

On account of the character of the ground, it was necessary to carry all of the buildings on piles. For this purpose concrete piles 16. in. in diameter were used, making it possible to carry the depth of footing course only below the frost line instead of down to water line, as would have been the case had wooden piles been used. All foundations are of concrete.

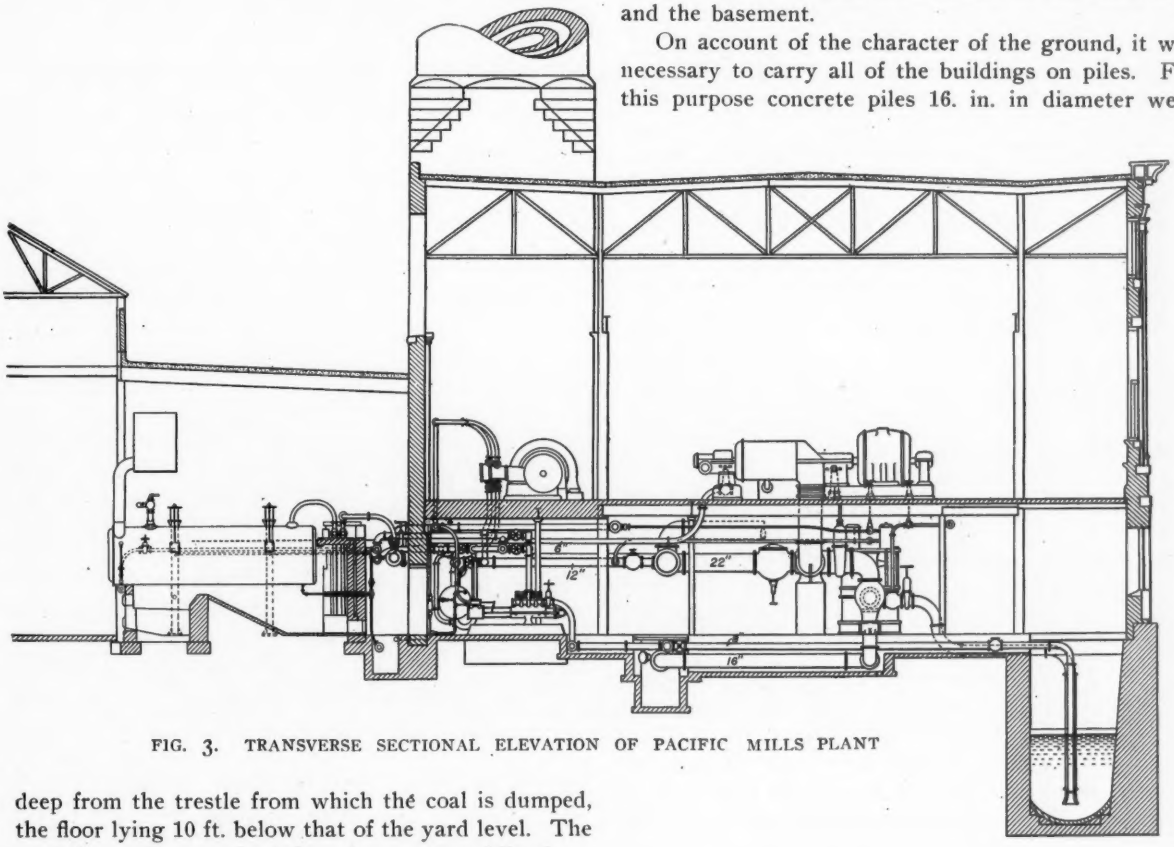


FIG. 3. TRANSVERSE SECTIONAL ELEVATION OF PACIFIC MILLS PLANT

Coal Handling

Coal is handled from the pocket by a Whiting Foundry & Equipment Co. single-track trolley with a grab bucket. In the coal pocket there are 2 lines of track, supported on each side of the trestle, the trestle being supported from the roof trusses. Outside the pocket near the boiler room these 2 lines unite and the single line of track is carried down over the center of the firing floor in front of the boilers.

Boilers

The present boiler installation includes 12 horizontal return-tubular boilers built by the Bigelow Co., arranged in batteries of 4 each. Space for a similar equipment has been provided on the opposite side of the boiler room with a similar chimney. Each boiler has an overhanging front. There are 92 tubes 3.5 in. diameter and 20 ft. long. The boilers are suspended by lugs and bolts from I beams carried on columns entirely independent of the settings. The latter are of red brick lined throughout with fire brick. New England roller grates are used. A steel flue with damper regulator conveys the products of combustion to the chimney. A Foster superheater is mounted in the rear of each boiler setting, giving steam superheated about 125 deg. F. Boiler pressure is about 150 lb. per square inch.

Turbo-Generator Units

On the generator floor are 3 750-kw. Allis-Chalmers turbine units, delivering 60-cycle current at a pressure of 2300 volts; a 75-kw. engine-driven alternator capable of running in parallel with the above; a 50-kw. exciter driven by an Ames Iron Works engine, a 55-kw. motor-driven exciter and a 12-panel switchboard. There is plenty of room for a duplicate of this equipment.

The turbines, designed to run at 1800 r. p. m., are of the multiple expansion type. Each is equipped with an automatic overload and safety stop valves and centrifugal governor. The generators are of the revolving field enclosed type with forced ventilation, air for which is sucked in by the rotating field through a duct leading to an air shaft opening near the roof. This insures a supply of clean cool air. Each turbine unit is furnished with oil by an oil pump mounted on its frame and gear driven from the shaft. At starting, oil is supplied by an auxiliary steam-driven oil pump. All auxiliary apparatus for the turbines including 2 1000-gal. Underwriter fire pumps of Knowles make is located in the basement. The boilers are fed by 2 12 by 8 by 14-in. Warren feed pumps in connection with a 300-hp. Wainwright closed feed-water heater made by the Alberger Condenser Co.

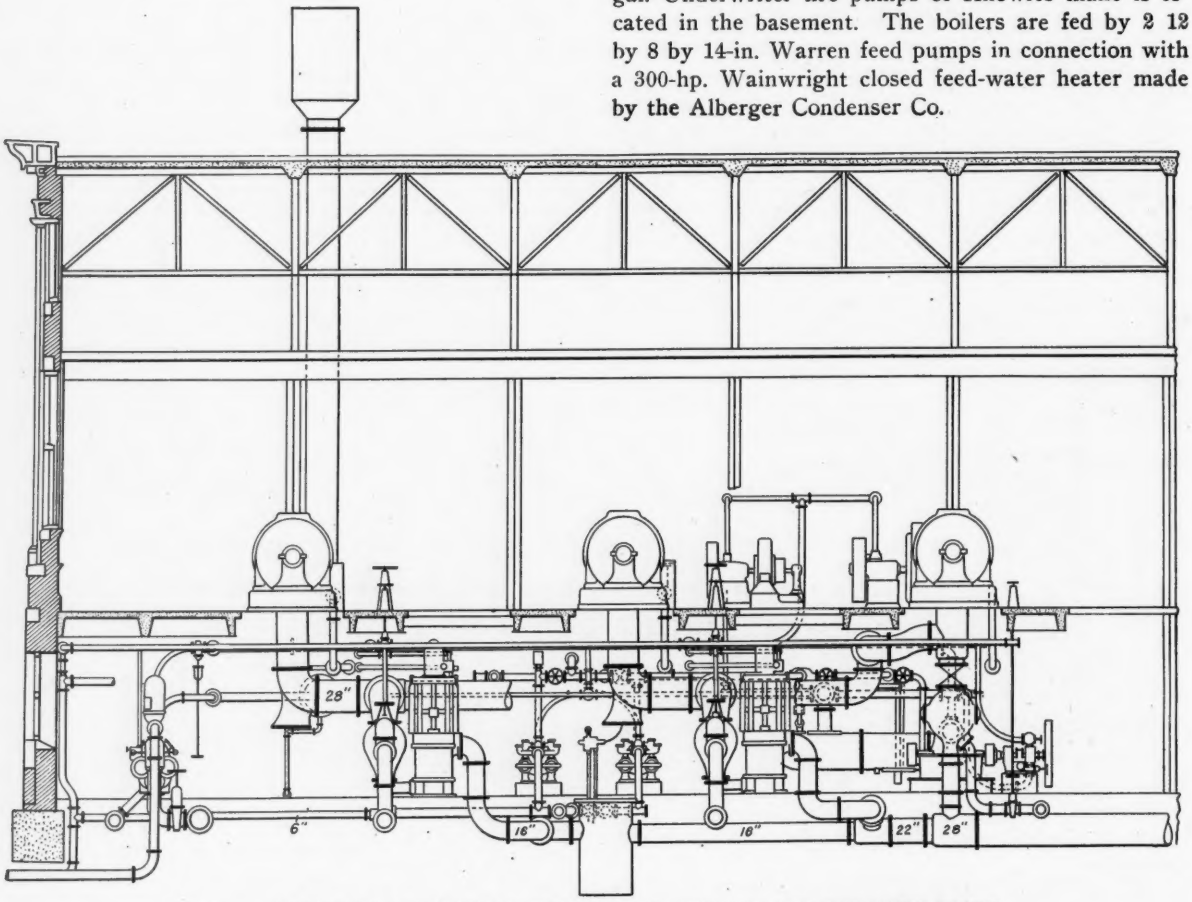


FIG. 4. LENGTHWISE SECTIONAL ELEVATION OF TURBINE AND CONDENSER ROOMS

Condensers

Two of the turbines are equipped with Warren jet condensers having twin double-acting steam driven air pumps. The third has a turbo-jet condenser set built by the Allis-Chalmers Co., which consists of a jet condenser directly beneath the exhaust nozzle of the turbine, with water supplied by a 3-lobe cycloidal pump driven by a small steam engine. Adjustable spray nozzles are fitted to all the condensers. Openings are left in the turbine room floor so that all condensing apparatus may be reached by the 15-ton crane.

Switchboard

At present the switchboard, supplied by the Allis

Chalmers Co., provides 2 panels for the direct-current side of the exciters and 1 for the auto-starter for the motor side of one exciter; 4 panels for the alternating current generators, each being fitted with a voltmeter, ammeter, a recording and an indicating wattmeter, 1 3-phase, single-throw, nonautomatic, hand-operated oil switch; a total load panel with polyphase indicating wattmeter. Chapman voltage regulator, a 3-phase ground detector, and a power factor meter; and 4 feeder panels each with an automatic hand-operated remote control 3-phase, single-throw oil switch and a wattmeter for each feeder circuit, all with the necessary accessories.

On a swinging bracket at the exciter end of the board are the exciter, voltmeter and synchroscope. The oil switches are mounted on the wall back of the board, with operating lever below the floor. The feeder leads are taken to the north end of the basement under the turbo-generator room, and there connected to the outside cables by switches. Machine and feeder leads are hung from the basement ceiling, while the rheostats are on the basement floor.

Transmission

The entire transmission system is carried under ground in a multiple duct of vitrified tile laid in concrete, all joints being wrapped with burlap soaked in cement. This conduit has only 2 ducts arranged side by side throughout its length, so that each duct has at least 1 surface exposed to the surrounding earth, thus avoiding a reduction in the carrying capacity of any cable, due to poor radiation. The underground system eliminates the use of all lightning protection. The cables for the present installation are of the 3-conductor, stranded copper type, insulated with varnished cambric and protected by a lead sheath. The insulation is for a working pressure of 5000 volts. Two sizes of cables, one circuit being of 4 0000-cables, 1 of 3 000-cables, and 1 of 2 000-cables, are used. Manholes are spaced on about 300 ft. centers. Racks are formed in the sides of these by projections of the brick from the inside of the walls. They have concrete bottoms, brick sides and concrete tops closed by cast-iron covers.

After leaving the boilers, the steam passes to the superheater and thence through a 4-in. nozzle with 2 valves and a bleeder into a 10-in. steel header, below the level of the turbine room floor and in the boiler room. Two long bends between superheater and header provide for expansion. The header, in addition, is supported by balanced levers hung from the roof trusses in order to make it as flexible as possible. The turbines and auxiliaries are fed directly from the header, the former being provided with valves at the header and steam chests, while the latter are fed from the header at 2 places. Bypass valves divide the header into sections. All possible expansion of steam piping is amply taken care of.

Water Supply

The water supply is taken from the Merrimac River through a 48-in. steel penstock provided with sluice gate and screens into a large concrete cistern under the west side of the turbine basement, the walls of this cistern forming part of the building foundations, with bottom sufficiently low to insure an ample supply at the lowest river water level. This cistern furnishes water for the condensers, feed and air pumps. Provision is made for use of city water for either the feed-water or fire pumps, although nominally the former takes water from the overflow pipe from the condensers, any excess being returned to the river at a point below the intake to the cistern. It is also arranged so that the warm water from the condensers

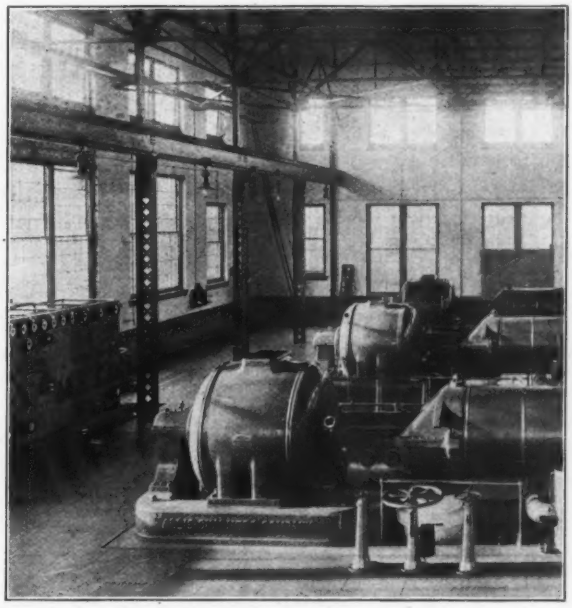


FIG. 5. GENERATORS AND SWITCHBOARD.

may be used for manufacturing purposes at the print works. The feed pumps ordinarily discharge through the heater into a 7-in. brass feed main in front of the boiler, from which the boilers are fed, but they may also be made to discharge directly into an iron feed main in case of accident to the regular feed pipe or feed-water heater. A Hancock inspirator supplies the boilers for night use. The Holly drip system is used on the high-pressure steam piping, and the drip is taken care of in the low-pressure system by means of V. D. Anderson Co.'s traps. A fourth Allis-Chalmers turbine unit, of 3250-kw. capacity, has been shipped on a rush order and is now practically installed, making the total capacity 5500-kw. normal or 8000-kw. on overload. A Tomlinson turbo-jet condenser is used with this fourth unit.

TRANSFORMATION OF CORUNDUM into precious stones by the action of radium is the latest wonder of that most unsettling of substances. By contact of 30 to 60 days Professor Bordass has changed colorless corundum into a topaz, blue into an emerald and violet into a sapphire.

REFRIGERATION

THE METHODS, MATERIALS AND MACHINERY USED

By Charles L. Hubbard

REFRIGERATION is the process of cooling, and consists in the transferring of heat from one body or substance to another, thus lowering the temperature of the former. In producing this condition mechanically, the latent heat of vaporization is taken advantage of.

It is a well known fact that when a liquid is changed to gaseous form a certain amount of heat is absorbed by the gas, although its temperature may remain the same as that of the liquid before evaporation. For example, a pound of water at atmospheric pressure, having a temperature of 212 deg. F., absorbs 966 B. t. u. in changing into steam at the same temperature and pressure. Saturated ammonia at practically the same pressure boils at a temperature of 28 deg. below zero and has a latent heat of 572 B. t. u.

Agents

It is evident that for cooling purposes a substance must be used which boils or vaporizes at a low temperature, and among those used for mechanical refrigeration may be mentioned ammonia, carbonic acid, sulphur dioxide and compressed air.

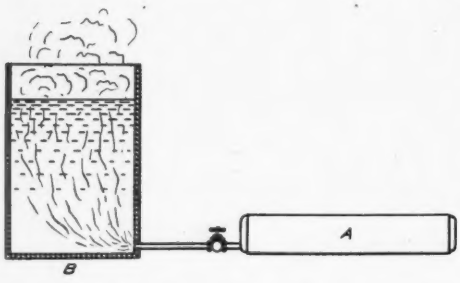


FIG. 1. PRINCIPLE OF THE COMPRESSION SYSTEM

Of these, the first is the most generally used in the class of work treated in this article.

Type of Machines

There are 2 general types of ammonia machines in use known as the compression and absorption machines; and as the details of the 2 systems vary somewhat they will be taken up separately.

Compression System

The principle upon which this system operates is best shown by the use of simple diagrams, after which some of the principal parts of the apparatus will be described more in detail.

Figure 1 illustrates one of the simplest forms of a refrigerating machine. This consists of a drum or flask A, containing a quantity of anhydrous ammonia, and connected by means of a pipe and valve with an open vessel B containing water or other liquid to be cooled.

By opening the connecting valve slightly the ammonia will be forced by the pressure in A into B where owing to the lower pressure it will at once vaporize, and in so doing absorb its latent heat of vaporization from the liquid in B, thus lowering its temperature. The objection to this simple form of machine is that the gas is wasted, which in practice would make the process very expensive.

Figure 2 while only a diagram, shows the machine and its operation in more practical form and illustrates how the escaping gas is saved and used over and over again.

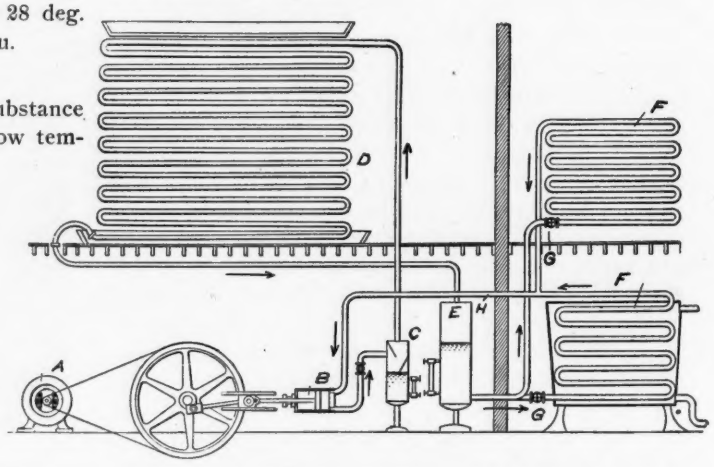


FIG. 2. DIAGRAM OF COMPRESSION SYSTEM AS USED

In Fig. 2, A is a motor, which in practice may be either an electric motor, steam or gas engine, or line shaft; B is a compressor, C an oil separator, D a condenser, E a liquid ammonia receiver, F F the expansion coils or evaporators, and G the expansion valves. The direction of flow of the gas and liquid through the pipes is shown by the arrows. Upon the lower floor, the evaporator is shown as being placed in a tank of brine, while the upper one is located upon the wall of a cold-storage room.

Starting with the machine in operation, we have liquid ammonia under compression in the lower part of the receiver E. The expansion valves GG are slightly open so that the liquid amonia flows slowly into the bottom of the coils FF. These being under a lower pressure, the liquid at once vaporizes, and in so doing absorbs heat from the surrounding medium, which in one case is brine and in the other air, and so reduces its temperature.

After vaporization, the gas rises to the upper part of the coils and is drawn into the compressor through the suction pipe as indicated by the arrows. From the compressor, the gas is discharged under pressure into the separator C where any oil which may be carried over from the cylinder is removed from the gas and falls to the bottom of the chamber.

From the separator the gas passes into the top of the condensing coil D which is cooled by water flowing over it in small streams. During the passage of the gas through the coil it gives up its heat to the cooling water and is condensed to liquid form before reaching the bottom of the coil from which it flows into the receiver E, thus completing the cycle.

Having obtained a general idea of the principles involved let us now take up the different parts of the operation more carefully and examine the various parts of the apparatus.

Compressor

This is similar in construction to any air pump, and consists of a cylinder and piston with suitable inlet and outlet valves, stuffingbox, cross head, etc., mounted on a suitable bed. In single-acting machines, the gas is compressed only at 1 end of the cylinder, while in the double-acting machine valves are provided at both ends and compression takes place on both forward and return strokes.

Some compressors are water jacketed to remove the heat of compression, being called dry gas machines; others not so provided are called wet gas machines, being kept cool by the wet or partially liquid gas returning to the cylinder from the evaporating coils.

Figure 3 shows a section through the cylinder of a water-jacketed, double-acting machine of medium size. In this the inlet valves are at the left and the outlet valves at the right. The jacket water surrounds the sides and head of the cylinder as shown. Compressors are made both vertical and horizontal. They are of the vertical type if single-acting, and either vertical or horizontal if double-acting, although the majority of the double-acting machines are of the horizontal type. The motive power used to drive the compressor varies with the conditions. Installations of 50 tons capacity and over are usually driven by slow-speed steam engines, while in smaller plants electric motors, gas or steam engines are used, either direct connected, geared or belted, or the compressor is driven from the main shaft.

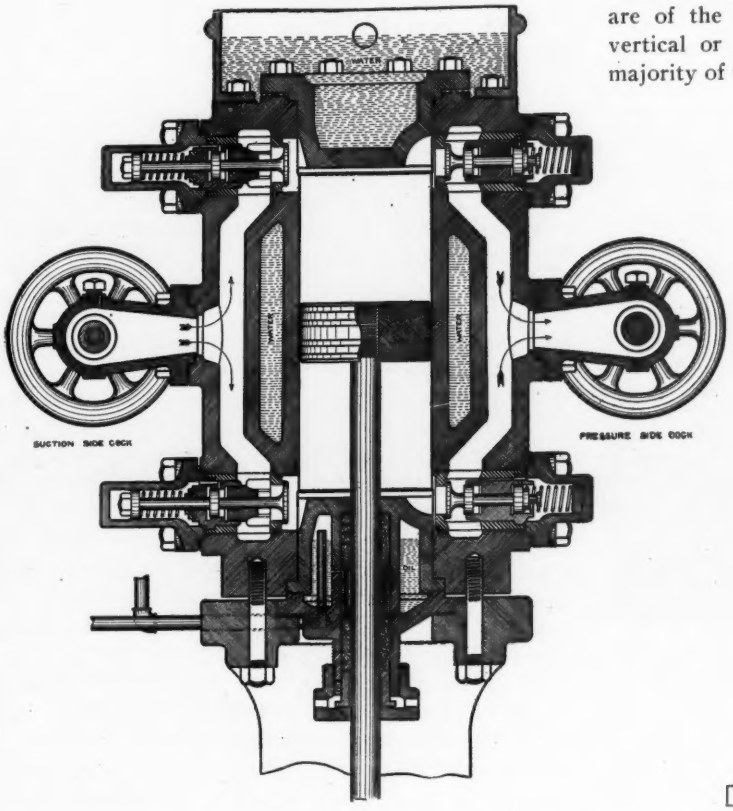


FIG. 3. SECTION OF WATER-JACKET, DOUBLE ACTING COMPRESSOR, BUFFALO REFRIGERATING CO.

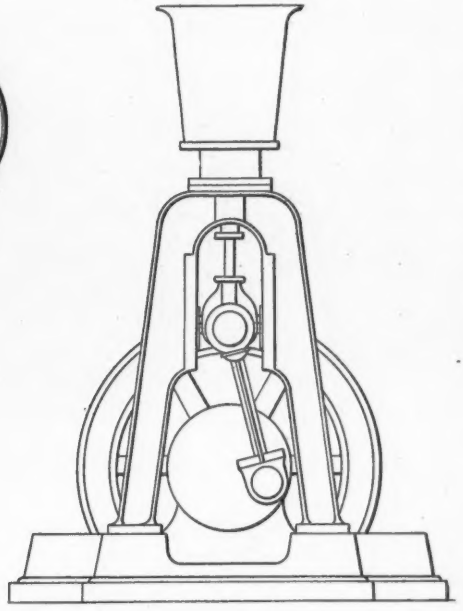


FIG. 4. VERTICAL, SINGLE ACTING COMPRESSOR FOR BELT DRIVE

Fig. 4 shows a small vertical belt-driven machine, and Fig. 5 one of larger size driven by a horizontal Corliss engine. It commonly requires from 1.5 to 3 horsepower per ton of refrigerating capacity, depending upon the size of the machine, the larger units having the higher efficiency.

Valves

The general form of valve used is shown in Fig. 3 where it is seen that the inlet valves open inward and outlet valves outward. To stop the valve in its opening and prevent shock, it is necessary to provide a buffer or cushion in addition to a spring to close it.

The cushion as usually constructed, is a piston fitting closely in a cylinder and provided with openings for the escape of gas in front of the piston until it reaches a certain point, which should conform to the lift of the valve; at this point the piston is prevented from traveling further by the compression of the gas and the valve is brought to a stop without noise or jar. The strength of spring for closing the discharge valves must be nicely gaged to secure the best results, and the best adjustment must be learned by experience rather than by any rules which can be given.

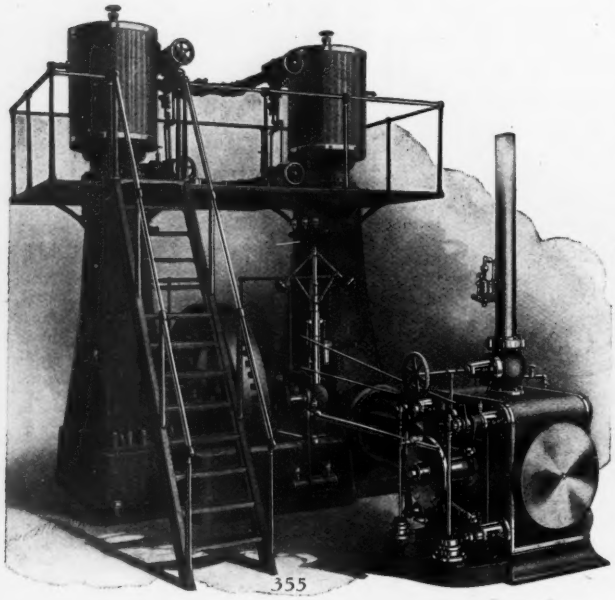


FIG. 5. YORK MFG. CO. VERTICAL COMPRESSOR

Piston

The compressing piston is commonly of the grooved type with from 3 to 5 snap packing rings. It is also well to turn a small half-round oil groove in the outer face of the piston between each ring which gathers and retains a portion of the oil for lubrication, thus increasing the efficiency of the piston, collecting dust or scale and lessening the liability of cutting the cylinder.

The stuffingbox of the compressor is one of the most difficult parts to keep in proper order due to the great difference in temperature to which it is subjected. Another cause for trouble at this point is imperfect alignment of the stuffingbox and crosshead guides. If these are perfectly in line, there is very little trouble in keeping the packing tight.

In the vertical type of compressor it is usual to provide a water jacket, which may be cast in combination with the cylinder as shown in Fig. 3. It is common to have this extend around the middle of the compressor and over the cylinder head; the object being to keep these parts at a normal temperature, both for preventing damage to the joints and increasing the density of the gas as it enters the cylinder.

In the operation of the plant it is well to have plenty of water flow through the jacket, as the cooler the compressor is kept, the better, but in plants in which water is scarce the quantity may be reduced correspondingly until the overflow is upwards of 100 deg. In extreme shortage of water, the overflow from the ammonia condenser is sometimes used in the jacket.

Lubrication.

Lubrication is another important point to be considered. The vertical type of compressor requires the least amount of lubrication because all of the moving parts are balanced. The slight amount of oil used is merely to keep the surfaces from becoming dry.

Excessive lubrication is objectionable, owing to the insulating effect upon the condensing and evaporating surfaces of the system, hence it is well to feed as little oil as will answer to keep the moving parts running smoothly.

In order to prevent oil being carried over into the ammonia condenser, a good form of separator should be placed in the discharge pipe. The oil is best supplied by means of sight-feed lubricators, preferably of the reservoir type.

Owing to the action of ammonia on animal or vegetable oils, these must not be used in the compressor, the principal oil for this purpose being the West Virginia Natural Lubricating Oil or Mount Farm, which is a dark colored oil not affected by the action of ammonia or the low temperature of the evaporator. More lately some of the oil refining companies have put on the market a light colored oil which seems to give good results.

CHIMNEY LIGHTNING RODS

IN THE Journal of the American Society of Naval Engineers, Dr. N. Monroe Hopkins, electrical engineer for the Navy Department, tells of some interesting experiments made to determine the behavior and effect of high-frequency discharges upon a model chimney.

A Tesla oscillator, capable of striking through an air gap of 4 ft., was used, the model chimney and its conductors being subjected to electrical discharges at a voltage of 1,800,000 and a frequency of 200,000 oscillations a second. The results appeared to show that a chimney could be protected from damage by lightning by the use of several conductors from the top equally spaced, and a copper spider on the top of the chimney connected to these conductors, the spider

being to prevent a stroke following a current of hot air into the chimney.

Practical conclusions from the experiments follow, those relating to chimneys being specifications, which have been approved for the installation of lightning conductors on the brick power plant chimneys of the department. The accompanying illlustrations represent the top of the chimney, showing the spider and an earth plate and points.

For the complete protection of a central power plant, its roof and trusses, together with all other masses of metal without and within the building, should be metallically connected with chimney conductors as well as to conductors running along the

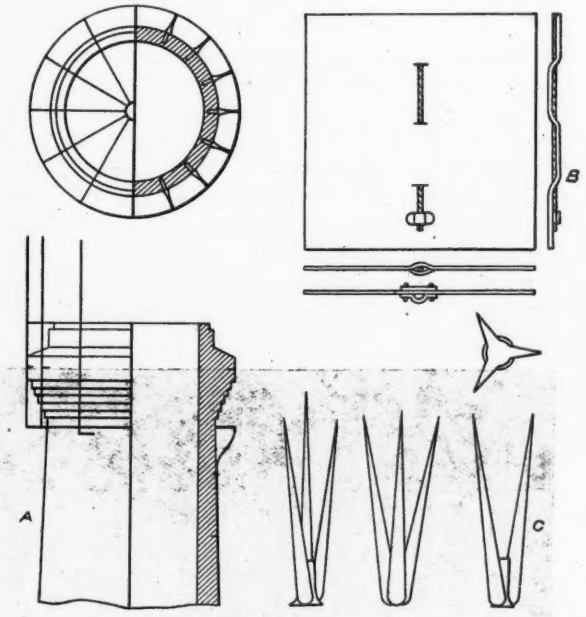


FIG. I. DETAILS OF LIGHTNING RODS, U. S. NAVY DEPARTMENT. A, ARRANGEMENT OF SPIDER AT TOP. B, DETAIL OF GROUND PLATE. C, APPROVED FORMS OF AIGRETTE FOR TIPS OF RODS.

top of all roofing and other prominent parts of the building. Sharp points should be placed at close intervals somewhat analogous to the protection afforded by the barbed wire netting used in Europe about the buildings of dynamite factories. As the architecture of the building must necessarily dictate the precise arrangement of conductors, the specifications given below pertain only to the protection of the chimney, which, if properly provided for, because of its towering height, affords also good protection for the building.

Chimney Protection for Power Plants

Lightning conductors shall be laid up in the form of a 7-strand cable, and each strand laid up with 7 copper wires of number 10 B. & S. gage. For chimneys of 50 ft. and less in height, 2 lightning conductors shall be used. For chimneys over 50 ft. up to and including 100 ft., 3 conductors shall be installed. For chimneys higher than 100 ft., 4 conductors shall be installed; all heights to be considered from the ground level.

All conductors or cables shall be symmetrically arranged about the chimney with one cable on the prevailing weather side of the chimney.

Said lightning conductors or cables to be securely attached both mechanically and electrically to independent pure copper earth plates or bars. In cases where the chimney foundations have already been filled in, instead of earth plates, earth terminals may be used, composed of pure copper bars 3 in. by 0.5 in. by 3 ft. In all cases the lightning conductor terminals shall extend to the ground water level, and in no case shall they extend less than 15 ft. from the ground surface. Earth plates shall consist of pure copper 3 ft. by 3 ft. by ⅛ in.

Application of Conductors to Chimney

Each lightning conductor shall be secured to the exterior of the chimney by means of bronze or brass anchors, without the intervention of any insulators or insulating material whatever. The brackets for attaching the ring or conductors to chimneys to be of high grade bronze or brass, and to be fitted with approved clamps for securely gripping said conductors and making good electrical connection therewith. The tongues or shanks of the anchors or brackets shall enter the masonry of the chimney a distance of at least 6 in., and shall be at least ⅛ in. in thickness by 1 in. wide, terminating in a suitable head or angle, to prevent the anchor from being pulled out of the masonry. Anchors to be attached to conductors at intervals of not over 10 ft. and sweated to the conductors with solder at intervals of 50 ft.

Conductors to terminate within 5 ft. of the top of the chimney, and to be connected through the agency of suitable brass or bronze fitting and soldered to a 1.5-in. ring of copper attached to the periphery of the chimney by brackets spaced not over 2 ft. apart; said brackets to enter the brickwork a distance of at least 6 in., and to be of approved design, with a tongue at least 1.5 in. in width and 0.25 in. in thickness, with a suitable angle or head to prevent pulling out.

All joints in the said copper ring, as well as between the ring and conductor or conductors running down to the ground bars or plates, and including the latter, to be scraped bright, and, after making a secure mechanical joint, to be "sweated with solder." Said solder shall consist of 0.5 lead and 0.5 tin. All joints when finished shall be thoroughly washed off with water to remove every trace of soldering salts, acids or other compounds used. All joints secured by bolts or screws with lock nuts. In applying conductors where the chimney is already constructed, holes shall be drilled in the brickwork and said anchor brackets and anchors grouted in, the best Portland cement being used.

GAS ENGINES AND PRODUCERS

GASOLINE ENGINE HIGH PRESSURE PUMPING STATION OF TRENTON, N. J.

By H. H. Yates

LIKE most American cities, Trenton, N. J., possesses features peculiarly its own. Bordering on the Delaware River, traversed by the Delaware & Raritan Canal and its feeder, the Assaupink Creek, the canal of the Trenton Water Power Co., and several small streams or brooks, it may well be called a City of Bridges, for within its limits may be found over 50 crossing water, besides numerous railroad bridges.

Yet in spite of all this water so conveniently at hand, at times it seemed as if although there was "water, water, everywhere," there would soon be "not a drop to drink," did not the water commissioners keep busy and every 2 or 3 years enlarge the capacity of the pumping station and reservoir.

FIG 1. TRENTON HIGH PRESSURE PUMPING STATION

It is well within the memory of the writer when the equipment of the station consisted of a small walking-beam pump and a Worthington horizontal compound pump.

An 8,000,000 gal. capacity Allis-Chalmers triple expansion unit was installed, the station enlarged and improved; a few years later a 15,000,000 gal. Barr, of the same type, was added, and now bids have just been received for a machine with a capacity of 20,000,000 gal.

The reservoir capacity necessarily increased in proportion. About 10 years ago a large new reservoir was built, which was expected to supply the needs of the city for many years to come. Being located on very high ground, it was supposed that no trouble would be met with in getting water to the upper stories of buildings, but as the city grew and suburbs were annexed, considerable territory on the north was taken in which is fast becoming a fine residential section. Formerly known as Hillcrest, it is, as its name indicates, located on very high ground, and this introduced another problem for the water commissioners to solve, as at times it was impossible to get water above the first floor.

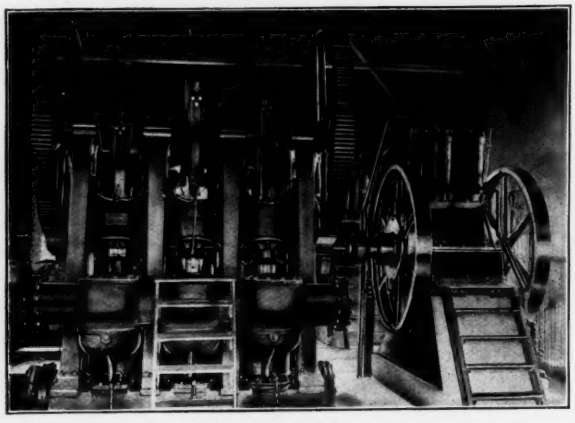


FIG. 2. INTERIOR OF TRENTON STATION

This difficulty was overcome by constructing at the base of the reservoir, a standpipe 90 ft. high, 25 ft. in diameter, with a capacity of 330,500 gal. To supply this a pumping station was built which contains 2 units with a capacity of 1,000,000 gal. each per 24 hr., space being reserved for a third. Nash 2-cylinder, 4-stroke-cycle engines using gasoline, furnish the power for driving the pumps. The cylinders are 7 in. diameter, 10-in. stroke, and operate at a

speed of 240 r. p. m., with make and break ignition, hit or miss governing, and are rated at 22 hp. each with 1 pint of gasoline per horsepower per hour; but as they are not worked to their full capacity at all times, due to the level of water varying the consumption averages about 18 pints an hour.

The oiling is done with sight feed oil cups. The cooling water is taken from the delivery pipes and after circulating is discharged to pit in basement.

As the station has been in use but 4 months, it is rather early to make any statements concerning the reliability of the equipment, but up to the present time everything has worked very well. At the time of the writer's visit the engines and pumps were working as smoothly and quietly as any other type of engine possibly could.

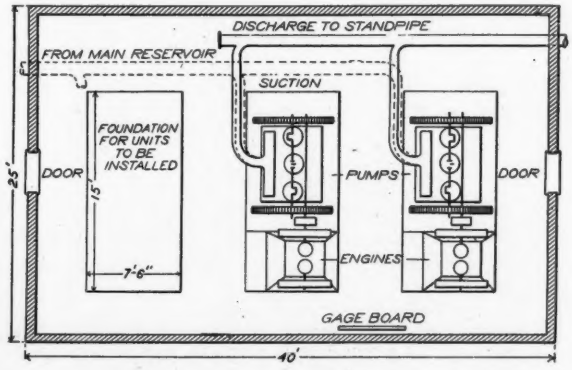


FIG. 3. SHOWING PLAN OF STATION AND ARRANGEMENT OF UNITS

The gasoline storage tank is located outside the the building, and underground.

The pumps are vertical, 3-cylinder, made by the Platt Iron Works. The plungers are 14 in. diameter with a stroke of 12 in. and having a gear ratio of 1 to 8, operate at 30 r. p. m. A revolution counter is attached to the frame of each pump.

Lubrication is effected by means of the usual oil and grease cups.

The delivery pipes are 10 in. diameter, both pumps discharging into a common pipe to the standpipe, the 12-in. suction pipes taking their supply from a common pipe from the reservoir, as shown on the plan. As the water flows to the pumps with a head equal to the height in the reservoir, it is only necessary to overcome the pressure due to the difference in the levels of the 2 bodies of water.

Between the engines and pumps are Crane and Whitman friction clutches, which are necessary in starting.

As can be seen by reference to the plan view, Fig. 3, the engine shaft is in line with a shaft extending across the pump just back of the pump crank shaft, the pinions on this shaft engaging with the large spur gears at each end of the pump crank shaft.

Each unit is on a concrete foundation, 7.5 by 15 ft., the part under the engine being elevated in order to bring the engine shaft in line with pinion shaft of the pumps. The space for the third unit, as shown in the drawing, is in front of the units in operation, the foundation being built but covered by flooring. In case of needing another pump it will only be necessary to remove this and erect the machinery.

The standpipe is of steel, 25 ft. diameter, 90 ft. high, covered by a conical hood. Heavy anchor bolts imbedded in the foundation assist in holding down the pipe. The usual means of inspection and cleaning are provided.

The basement contains the suction pipes and exhaust muffler, the latter being an efficient piece of apparatus, as the exhaust is scarcely audible, even close at hand.

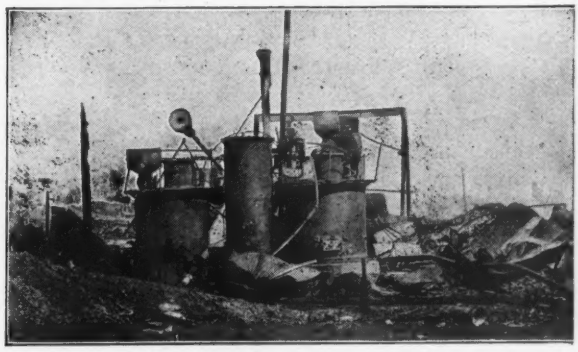
At present, about 8 hr. pumping suffices to keep up the supply. As 1 man is able to care for the place at present, the operating expense is low, there being no standby cost for fuel.

The cost of the complete installation was $31,000 which, considering the reserve capacity, 3,000,000 gal. being provided for, is not excessive.

THE CHISHOLM ELECTRIC PLANT

THE City of Chisholm, Minn., with a population of about 6000 inhabitants, is located about 65 miles north of Duluth, and is surrounded by iron mines of the Mesaba Range.

Some years ago, a small steam-driven electric light plant was installed by local private parties, but in 1906 was taken over by the Range Power Co., who entered into a 20-yr. contract for the city street lighting. The plant was enlarged by the installation of a 350-hp. Weber 3-cylinder, vertical gas engine, direct-



THE BURNED CHISHOLM PLANT

driving a 225-kw. Allis-Chalmers alternator, 60-cycle, 2300 volts. The engine was supplied with gas from a Weber suction gas producer, and has been in operation about a year. The fuel used has been the screenings from anthracite, also coke breeze, which is a by-product at the receiving docks in the Duluth mines.

They also tried out charcoal breeze, all of which

fuels worked out entirely satisfactory in the producer gas plant. The consumption in regular service being from 0.93 to 1.05 lb. per brake horsepower-hour.

The growth of this town has been reasonbly rapid, owing to the opening up of a number of large iron mines in its immediate vicinity, so that with the increasing demand the Range Power Co. installed, during the summer, over 50 flaming arc lamps, and everything about the plant was put in most excellent condition to meet the increased demand for the fall and winter load.

During the last week of August the forest fires throughout the range became threatening, and on the afternoon of the 30th, it overcame the heroic efforts to combat the flame and swept through the town, destroying every business building with a single exception.

The Power Co. had rigged up a temporary pumping plant, which was being used, and the engineer stuck to his post gallantly until the power house was in flames and he had to jump into the lake and swim out to a boat for refuge. He returned the next day and photographed what remained of the light plant, as seen in the illustration.

The owners, with remarkable fortitude, immediately placed an order with the Weber Gas Engine Co. for a 150-hp. gas engine and gas producer. The city council of Chisholm has voted an issue of $250,000 in bonds for the reconstruction of the sidewalks and street paving, and the 6000 inhabitants are all busy re-establishing their homes.

SUCTION GAS PRODUCER POWER

AMERICAN PRODUCERS FOR AMERICAN COALS AND LIGNITES

By L. P. Tolman

THAT producer gas power is a pronounced success in the United States is evidenced by the large number of satisfactory installations already in operation on American coals. It is estimated that there are over 500 producer power plants in this country, having an aggregate of 150,000 horsepower. Of these, about 85 per cent are of the suction type and 15 per cent of the pressure type. The suction plants average approximately 100 horsepower each, while the pressure plants are usually built in sizes larger than 1000 horsepower.

Arrangement

Figure 1 illustrates a suction gas producer power plant. The apparatus is simple, reliable, and economical. With this plant about 18 per cent of the total energy of the fuel is converted into useful work varying acording to conditions from 15 to 21.5 per cent. This means that a small suction gas producer plant uses from ½ to ¼ as much coal for a given amount as a steam plant of the same size.

A 150-hp. suction producer plant, running 2/3 load, 3100 hr. a year, uses approximately 1.5 lb of

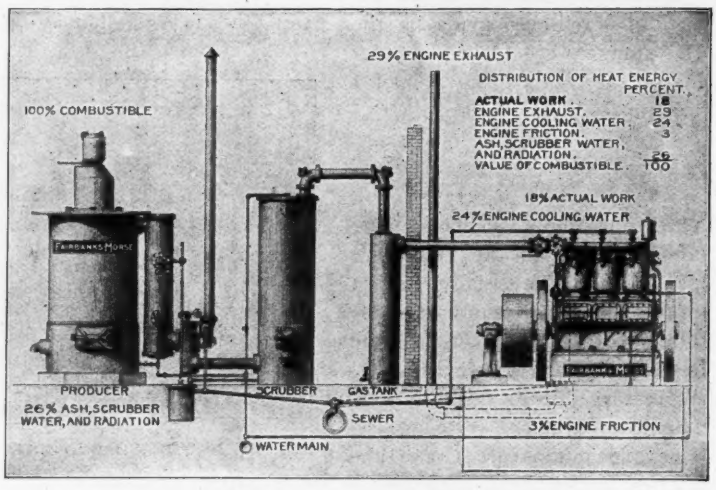


FIG. I. SUCTION GAS PRODUCER POWER PLANT

This article deals with suction gas power plants in single units of 200 horsepower, or smaller, and complete plants made up of a number of such units 1000 horsepower, or larger. This range of sizes covers the requirements of the great majority of power users.

coal per brake horsepower per hour. Tests have been made showing a consumption of less than 1.25 lb. at 2/3 load and less than 1 lb. at full load. With anthracite at $5 per ton, the fuel alone costs $1162.50 per year. Furthermore, the cost of attendance can be re-

duced materially with a producer plant, as the operator can spend part of his time in other useful work.

Government Tests

Much valuable information is given in the report of the United States Geological Survey concerning the fuel testing plant at the Louisiana Purchase exposition, St. Louis, Mo. For 3 years the government experts conducted a series of tests on many samples of coal from mines all over the country. Briefly, the apparatus included a noncondensing Corliss engine steam plant with water-tube boiler and a pressure type producer with 3-cylinder, vertical gas engine.

From the summary of results obtained from a long series of tests, the fuel consumption in the pressure type producer plant varied from 1.18 to 3.41 lb. per the brake horsepower per hour, the average being approximately 1.75 lb. The average with the Corliss steam plant was found to be approximately 4.5 lb., using similar fuels. With lignite, the consumption in pressure producer plant was from 1.95 to 3.47 lb. With Corliss steam plant using lignite, the average consumption of "coal as fired"—not "dry coal"—was approximately 7 lb.

While most of the above tests were on bituminous coals, which cannot be used advantageously in a suction producer, yet the consumption of anthracite in the latter is usually less than as stated for bituminous coal in pressure type producer, probably due to the fact that there is less resistance to the flow of gas in the suction type. For example, tests on lignite in a suction producer commonly show a consumption of 2 to 2.25 lb., whereas from the 5 lignite tests at St. Louis the average is 2.60 lb. in a pressure producer plant.

Advantages of Suction Gas Producer Power

We have already discussed the high thermal efficiency of the suction gas producer plant. The most important and the most practical commercial advantage is the economy effected in the cost of developing power. Other advantages may be summed up briefly.

Simplicity. The producer, in which fuel gas is generated from coal, is almost as simple as an ordinary furnace for heating purposes. The gas engine is entirely automatic in operation and needs little more than the ordinary cleaning and care as to lubrication.

Absolute safety. There is no danger from explosion or from fire. It is absolutely safe, even in the hands of men with little mechanical training, and the many plants which are in continuous operation, some of them 20 and even 24 hr. a day, indicate that they are thoroughly reliable and will stand hard, everyday usage.

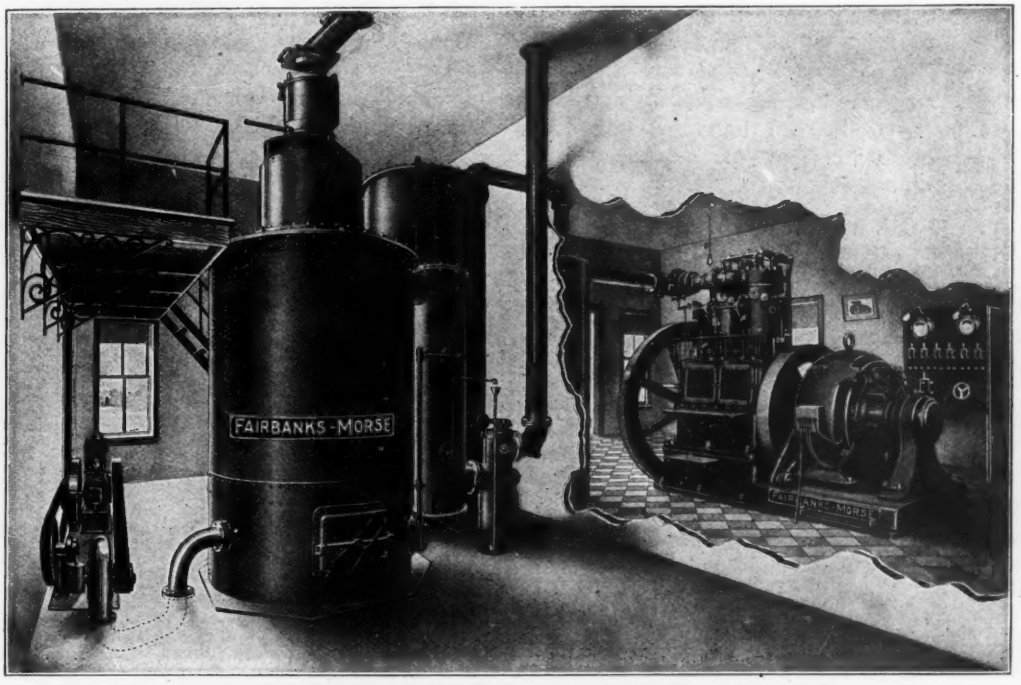


FIG. 2. FAIRBANKS-MORSE SUCTION GAS PRODUCER AND ENGINE INSTALLATION

No smokestacks and no smoke. Hundreds of thousands of dollars which are now spent annually in building smokestacks can be saved; and what is of greater importance, the smoke nuisance can be entirely abated. Such an ideal condition seems almost incredible to those who are not familiar with the subject.

Starting. The producer will hold fire all night or even for several days, and the proper quality of gas can be generated after 15 or 20 minutes blowing to revive the fire. The engine can easily be started on compressed air, and after getting up to speed it is then operated on producer gas.

Suction Gas Producers

Figure 2 illustrates an exterior view and Fig. 3 a sectional view of a Fairbanks-Morse anthracite suction gas producer. All of the principal features are clearly shown. Coal is admitted to the producer through a hopper at the top. This has double closure, so that fuel can be introduced without at the same time admitting air . In the process of partial combustion which takes place, producer gas is generated.

The hot gas passes through a vaporizer in which a small amount of steam is formed which, with a limited amount of air, passes under the grate of the producer. In the smaller sizes, the vaporizer is at the top of the producer where it uses the waste heat from the escaping gas and where, at the same time, the water keeps the top from getting too hot. In the larger sizes the vaporizer is separate and connected to the producer by piping.

From the vaporizer, the hot gas flows through the scrubber, which is merely a cylindrical tank filled with coke, over which a spray of water is constantly sprinkled. The large contact surface of the coke effectually cleanses the gas of dust and impurities carried over from the producer, and also acts to cool the gas, which is essential in order to prepare it for use in the engine.

With certain fuels, especially when much tar is encountered, it is also necessary to add a sawdust purifier in order to abstract the last traces of tar from the gas. While not absolutely essential, yet it is always advisable to use a gas tank between the scrubber and the engine, in which a certain amount of gas is stored in ready use for the engine. This is especially desirable where the loads are variable.

In the care of the producer, the principal attention needed is to poke the fire every few hours, according to quality of the coal, in order to break up and remove clinkers, which would otherwise interfere with the making of sufficient gas. Poke holes are provided so that every part of the fire can be reached conveniently.

TO KILL THE NOISE of a gas engine exhaust, take a piece of pipe about 80 in. long and split it with a saw, widening the slots toward the open end to a width equal to the diameter of the pipe. Put this section of pipe on the end of the exhaust pointing upward and the gradual expansion of the gases through the slot will kill the noise.—Penberthy Engineer.

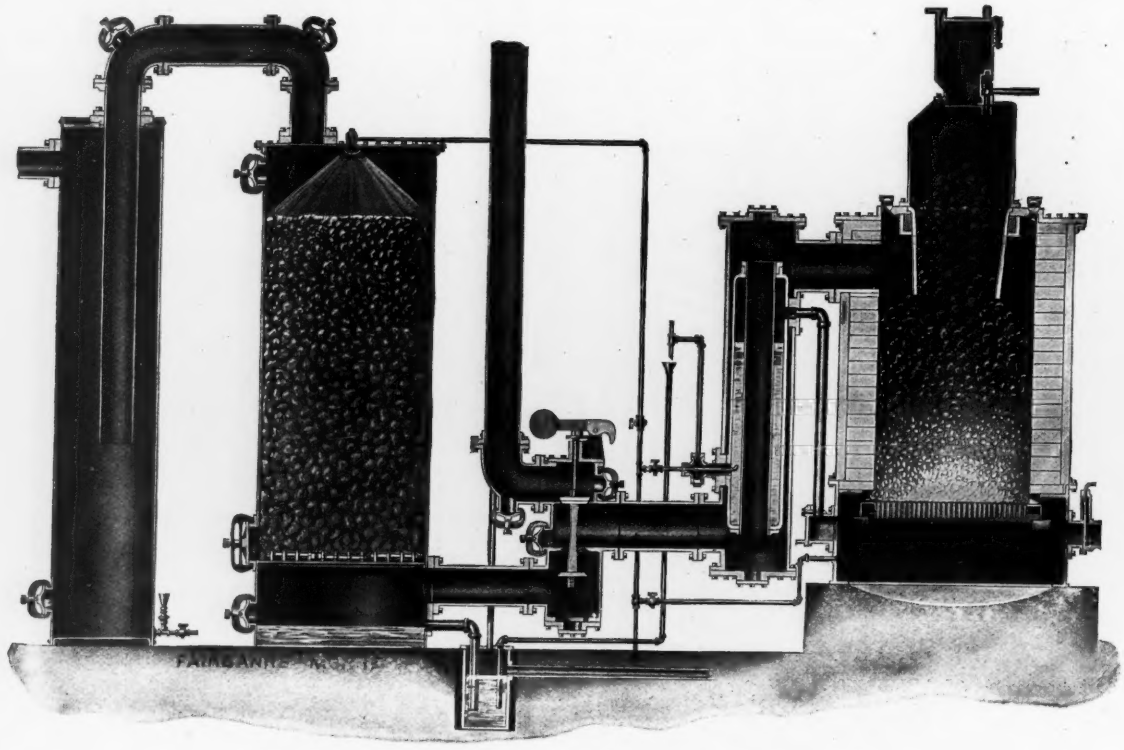


FIG. 3. SECTION OF FAIRBANKS-MORSE SUCTION GAS PRODUCER

GAS TURBINES are still in the experimental stage, but are making progress. In France, a 300-hp. machine has been run successfully in experimental work, taking a mixture of gas and superheated steam through nozzles to a wheel of the Rateau type, and similar machines of 120 hp. are used in torpedoes as motive power.

"YOU CAN WIN ten times as many friends by talking happiness as you can by talking trouble; and the more real friends you have the less trouble you will have."

ELECTRICAL MACHINERY AND APPARATUS

INSTALLING DIRECT-CURRENT MOTORS AND GENERATORS*

IF AT all possible, the machine should be in a clean, dry, well-ventilated room, away from combustible material and where there is good light.

Foundation

This should be solid and big enough to insure smooth running. If of concrete, which is preferable for heavy machinery, it should be 2 parts sharp sand, 5 parts broken stone and 1 part Portland cement. Foundation bolts should be provided to hold bed plates or rails in position. The best way to set these is to put in pipes 2 in. larger in diameter than the bolts and arrange pockets in the foundation for anchor plates and nuts which can be got at for adjusting the nuts. After the machine is permanently placed, fill in around the bolts with cement.

For machines of less than 50 kw. or

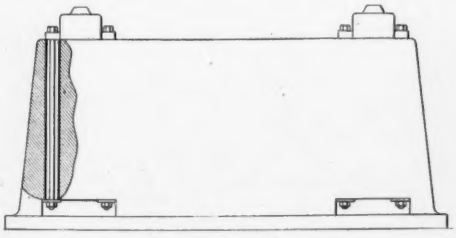


FIG. 1. DYNAMO FOUNDATION AND BOLT SETTING

50 hp. a heavy wooden framework will usually be sufficient.

Setting Up

For very large machines, a man skilled in handling and placing heavy parts is needed. Ordinarily, machines of medium size are shipped with field coils and poles on the yoke frame, but the yoke in 2 parts. Base and pedestals are together and the armature assembled, mounted on skids and wrapped.

For belted machines, the rails should be temporarily placed and approximately leveled, care being taken that they are wedged so that the weight of the machine will be distributed evenly. Then place the base on the rails and bolt it to them.

Set the lower half of the field yoke in position, placing dowel pins and bolting it down. Next place the armature in position, being very careful not to scratch the bearing surfaces of the shaft nor to bruise or injure commutator or windings. A rope sling is the best method for handling the armature, using a spreader to protect windings and commutator. All oil wells and bearings should be cleaned and the surfaces covered with oil before letting the armature down in place.

Carefully clean all contact surfaces of top and bottom halves of the field yoke, and place the top half in position, setting it carefully in relation to the bottom half. Level the machine, exactly, and line it with the pulley which drives it or which it is to drive. If possible, turn the machine over slowly with the belt loose and adjust while running so that the belt stays at the center of the pulley, while letting the armature move endwise freely in its bearings.

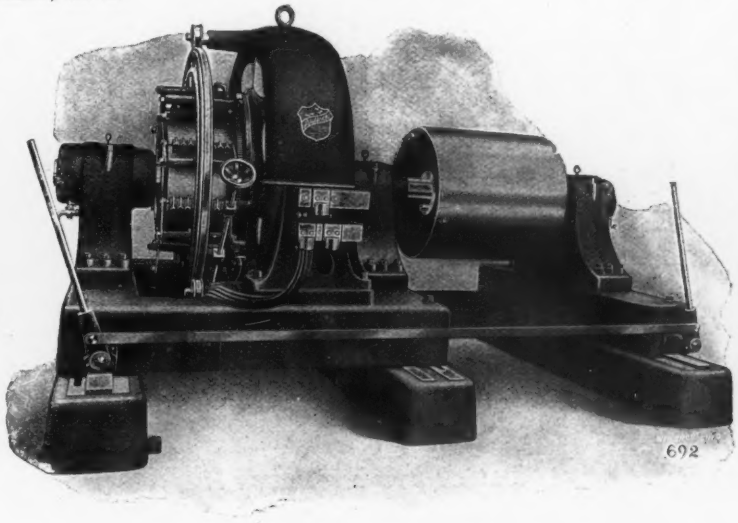


FIG. 2. 400-KW., 3-BEARING BELTED DYNAMOS

When all is level and aligned, tighten down the foundation bolts and "grout" in with cement around the bolts and rails. The cement used should be 1 part Portland cement, 1 part fine sand mixed with water to a thin liquid so that it can be poured under and around the rails. The spreading of the grout must be limited by a small dam of clay. When the cement is partly set, remove any surplus and smooth up the joint under the rails.

Large Direct Connected Generators

These do not have base, rails or bearings, the armature being carried on the engine shaft and the yoke on the engine base, or direct on sole plates on the engine foundations.

If sole plates are used, put them in position temporarily, supporting on iron wedges to allow of ad-

*From the Allis-Chalmers Co.'s Instruction Book.

justment. Place the lower half of yoke in position, inserting shims to ¼ in. thickness to allow for adjustment as the bearings wear down.

Using precautions as given for belted machines, locate the armature and engine shaft in bearings and place the top half of yoke in position, taking care that the air-gap is symmetrical at all points, and that the armature laminations and pole pieces are central with each other lengthwise of the shaft. Level the yoke by means of screws, if they are provided, but do not leave the weight on these screws. When level, insert shims to carry the weight. When finally bolted down, the leveling screws should stand free.

Grout in the sole plates, as explained for the rails of belted machines, and when the grouting is set tighten the foundation bolts and carefully check over the leveling and alignment of the machine.

Connecting Up

Carefully clean the series leads and clamping plates and bolt them securely together. Also see that all contact surfaces which carry current, such as terminal plates, armature lead terminals, etc., are cleaned and well fitted.

Assemble the brush holders on the rocker arm, setting them, if of the reaction type as shown in

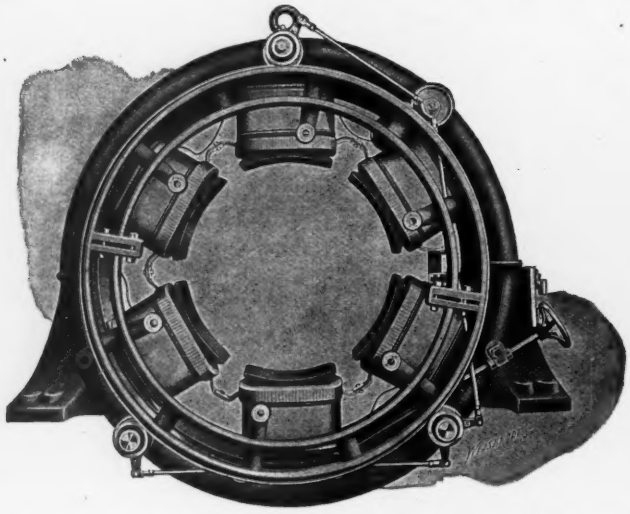


FIG. 3. 150-KW. ENGINE TYPE ALLIS-CHALMERS GENERATOR, FIELD YOKE AND POLES

Fig. 4, using a jig which is furnished by the builders. Arrange the brush holders on studs next each other, staggered, so that the brushes will not all follow the same path on the commutator, but will cover the whole surface. The holders should clear the commutator about ⅛ in. After setting, count should be made to see that there are equal numbers of bars between the brushes on different studs; if not, change the distance from holder to commutator to obtain equal spacing. The commutator should always run against the point of the brush in a reaction holder such as shown.

Fitting Brushes

For the first fitting use coarse sand or garnet paper and finish with fine sand paper. Hold the paper down on the commutator so as not to wear away the edge of the brush. Take out each brush and see that the entire contact surface is well fitted to the commutator. Be sure that the finger in the reaction type presses squarely on the brush so that it does not tend to

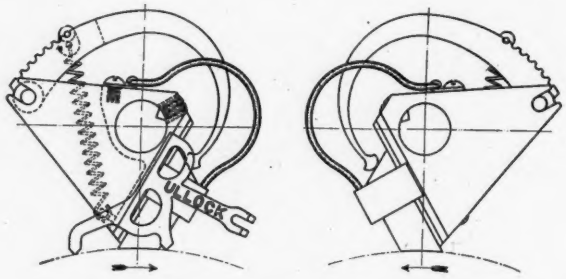


FIG. 4. SETTING OF REACTION BRUSH HOLDERS

throw the brush out of line. By moving the tension spring or otherwise, adjust the pressure on the brush until it is right, the exact amount being a matter of judgment; too little pressure will result in sparking

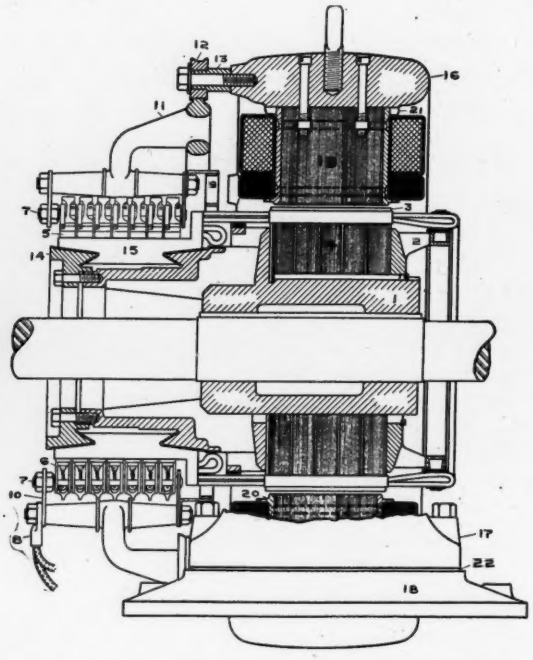


FIG. 5. SECTION OF ENGINE TYPE GENERATOR

and too great in excessive wear of commutator and brushes, waste of power and overheating.

Bearings

See that all oil wells are thoroughly cleaned and filled with a good mineral oil to a level that will insure the oil rings carrying oil to the shaft. Put the oil well covers in place to keep dirt out of the wells.

Wiring

This must be done in accordance with the rules of the insurance inspection bureau and any local rules that may be in force where the machine is to be run. Special care should be taken to get good soldered joints, well taped, careful running of wires and secure connections of all terminals.

Only approved wire should be used and of a size to allow 25 per cent increase in load without injury to the insulation.

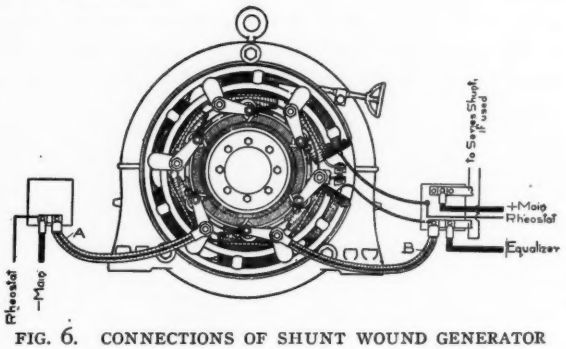


FIG. 6. CONNECTIONS OF SHUNT WOUND GENERATOR

Drying Out

If a machine has been in a cold place and is to be unpacked in a warm room, it should be left in the room until it has reached the room temperature, so as not to "sweat."

During shipment, the machine will gather some dampness and should be baked thoroughly, either by external heat or by current in the windings before it is put into service. If external heat is used, the machine should be boxed in, the temperature raised to 176 deg. F. To dry out with current, short circuit the armature through the series windings, putting an ammeter in circuit and gradually increase the speed until full load current is obtained. For a shunt wound generator, separate excitation will be necessary. For a motor, current may be sent through from the line, keeping a resistance in circuit to control the amount.

If a generator cannot be run at slow speed extra resistance in the shunt and series circuits will be necessary.

Starting Up

For a shunt wound generator, run the machine for a time at low speed without load and with the field circuit open. Study the mechanical running to see that it is smooth, that oil gages show the proper level, that oil rings are revolving and carrying oil.

Turn in all the field resistance and close the field switch. Gradually bring the machine to speed and then to voltage. Now note whether there is any tendency to force the armature out of position. Move the brushes by means of the rocker arm or ring until there is no tendency to spark.

Now close the circuit breaker, then the main switch and throw on load gradually, adjusting the field rheostat to balance the drop in voltage due to increasing the load.

If the generator does not build up, either it has lost its residual magnetism or the fields are wrongly connected to the armature leads. Disconnect the fields; separately excite for a few minutes and bring to voltage; then reconnect. If it will not build up, reverse the field connection to the armature.

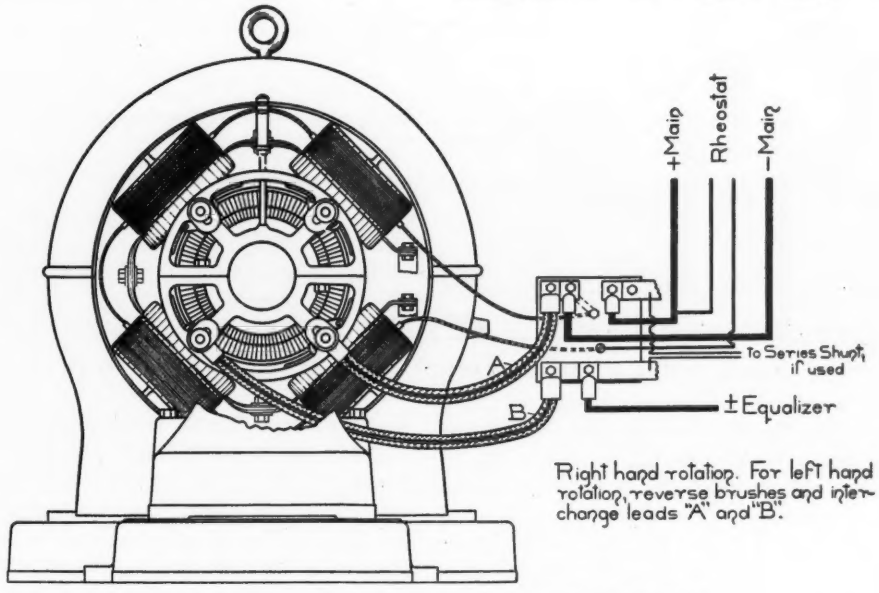


FIG. 7. CONNECTIONS OF COMPOUND WOUND DYNAMO

Compound Wound Generators

Take the same precautions as when starting a shunt-wound generator. When up to full speed and normal voltage, throw on the load, closing first the circuit breaker, then the main switch. If the voltage drops to any great extent, the series coils are opposing

the shunt coils and should be reversed. Where, as is usual, a shunt resistance is provided for the series coil, this should be adjusted to give the compounding effect required under normal operating conditions.

Shunt-Wound Motors

First, test out the field circuit and make sure that it is closed so that the field coils will take current and excite the machine. Do not attempt to start a newly installed motor until this has been done, as an open field circuit is likely to cause a burned out armature and a wrecked motor.

This test is easily made. If an automatic release starting box is used, remove the armature lead at the terminal marked "Arm" on the box and tape the end of the cable. Close the main switch and the starting box lever and note whether the release coil holds the lever in position. If it does, the field circuit is closed. With these conditions note with a piece of iron whether the poles give a strong magnetic pull. Slowly open the main switch and see if an arc results. All these are indications of a closed field which is safe. Open the main switch and replace the armature wire at the starting box.

If the box does not have an automatic release coil, the field will usually be connected through a separate field switch, and with the main switch open, the second and third tests can be applied by closing the field switch, testing for magnetic pull and for arc on opening the field switch.

With the field circuit O. K., close the main switch and cut out the starting box until the motor runs at full speed. See that the armature oscillates in its bearings, that it runs smoothly and that the oil rings are carrying oil. If the speed seems too high, check over the field connections to see that no coil is reversed.

Compound Motors

Instructions for shunt motors apply here. In case the speed is too high, the series coils are probably opposing the shunt. If enough resistance is available to make it safe, try the motor as a shunt and as a series wound. When trying as a series let it turn only a few revolutions, just to make sure that it runs in the same direction that it does on the shunt field alone. Make these tests with no load on the motor.

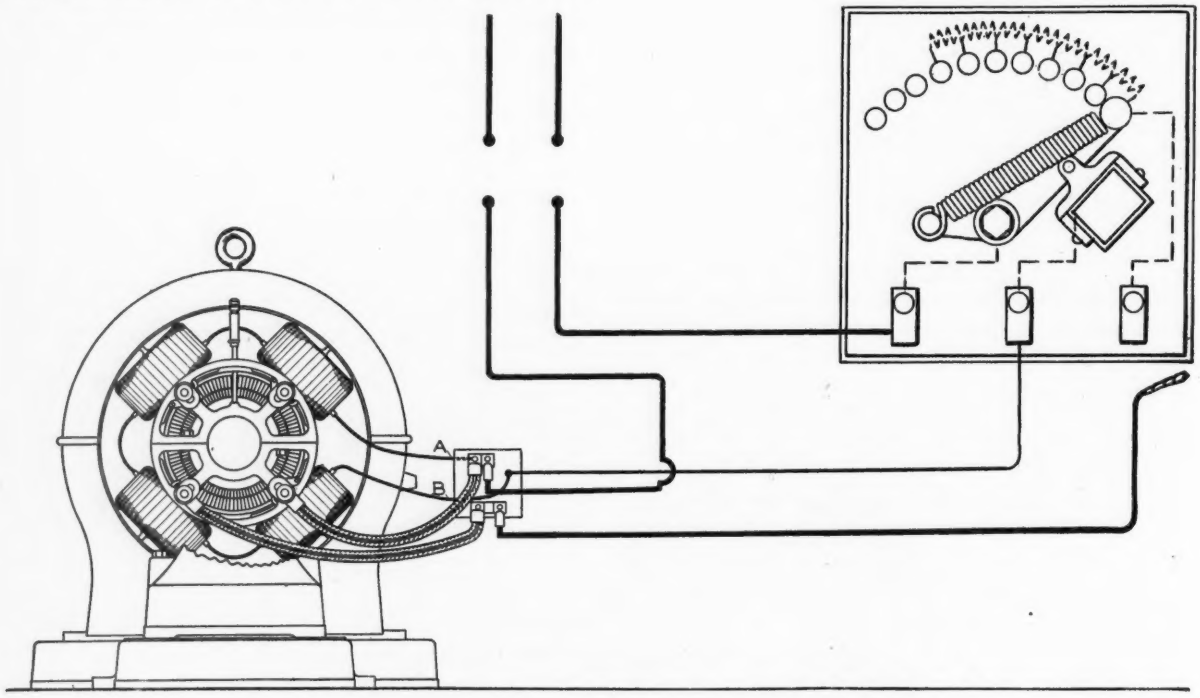


FIG. 8. SHUNT WOUND MOTOR CONNECTIONS AND TEST FOR CLOSED FIELD

Series Wound Motors

These must be carefully tested before attempting to start, but never try to start without a load as the motor will run up to a dangerous speed. When starting, use a large resistance in series, gradually cutting it out; on shutting down, cut the resistance back into circuit before opening the main switch.

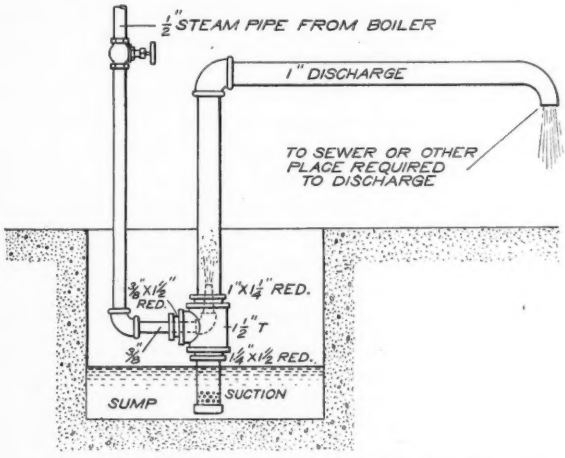
FOR LEATHER OR 3 or 4 ply rubber belts a good approximate rule is: Width in inches equals 1000 times the horsepower divided by the belt speed in feet per minute. To get the belt speed, multiply the revolutions a minute of the pulley by 3 1/7 times its diameter in feet.

REGULATE YOUR FIRE by the damper and not by the ash pit doors. Never open your fire doors when it can be avoided. To keep them open longer than is necessary in injurious to the boiler and wasteful of fuel.

BRIGHT IDEAS FOR THE PLANT

Home Made Ejector Pump

Herewith is a sketch of a home-made device that may be of service to some of the readers. A study of the print will probably make clear how the ejector can be made from odds and ends of pipe and fittings that usually are lying around a steam plant. I saw one in operation exactly like that shown in the print, and it worked splendidly. Any engineer can put the parts together, and if in any case the tapered nozzle



ARRANGEMENT OF HOME-MADE EJECTOR PUMP IN PIT

could not be made in the plant, it would cost but a trifle to have a blacksmith do the job.

Charles J. Mason.

Renewing Gage Glass

To avoid getting scalded when putting in a new gage glass when one breaks, if the column be not fitted with quick closing valves operated from the floor, open the blowoff to the water column and you can get up and shut the glass off without hunting some old clothes to throw over you. E. A. T.

Banking Fires

The method of banking fires I used for over 2 years successfully is very simple. I commenced 10 min. after 5, 5:30 being quitting time, to build up one back corner of fire until 5:20; then I put on 10 or 12 shovelfuls of coal, letting it burn 5 min., when I cover with ash, closing draft doors and flue damper nearly tight. The remainder of the fire is left to burn out, to be cleaned out in the morning before pulling down the fire. In the morning when I come I have 60 or 65 lb. steam. E. A. T.

Dashpot Repair

Most readers will probably know about those old style dashpots which were a kind of catch-basin for all the drip from the valve stems and were always full of water; so I made patterns and had some cast and then finished. The plunger is solid and screws on the engine bed instead of the cylinder as in the old type.

It has a hole drilled down through the center which connects to a hole for a taper plug to adjust the com-

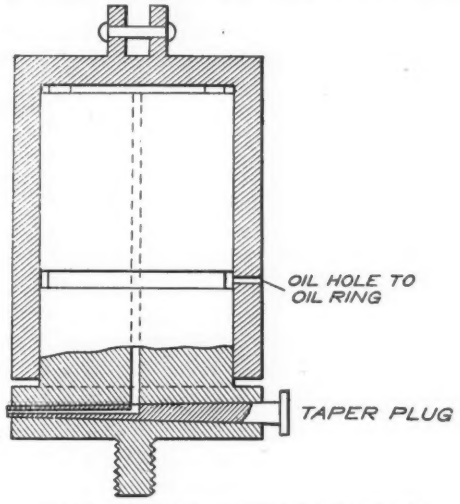


FIG. 1. SECTION OF THE NEW DASHPOT

pression, the plug being drilled as far as the hole in the plunger.

The plunger has an oil ring around it opposite an oil hole in the cylinder.

There is a leather ring on top of the plunger to stop the cylinder from slamming on top of the plunger when adjusting the compression.

I will send a card also from this engine which has run every day but Sundays for 37 yr.

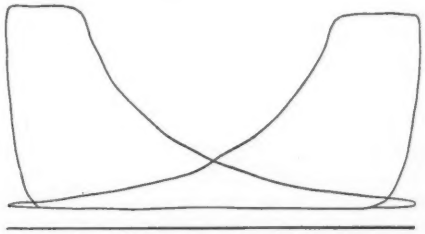


FIG. 2. DIAGRAM FROM A 37-YEAR-OLD

It is running on less than 4 lb. of coal per horsepower, soft coal and hard screenings mixed 4 to 1. The speed is 60 r. p. m.; steam pressure 90 lb.; cylinder 12.25 by 34 in.

I would like some one to tell me how I can stop the rattle in the gears, I use grease and graphite now.

O. W. R.

A READY RULE FOR CHIMNEY AREA is to make it 0.1 the area of the grate.

GOOD PAINTS FOR STACKS and boiler fronts are asphaltum cut down with turpentine or coal tar mixed with graphite and thinned with turpentine.

PRACTICAL ENGINEER

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THE HOLIDAYS

We hope that you had a joyful Thanksgiving; we wish you a Merry Christmas; and we trust that you may have a Happy New Year. Old and well worn sayings, these, but always new when they are spoken from the heart as they are now. The turkey is a memory, but we have the Christmas tide and the New Year to make as merry and as happy as possible—and it depends largely on each of us as to how merry and how happy they shall be.

The editors of Practical Engineer are working hard on a remembrance which will be sent you on Jan. 1, and which we hope will prove our good will to make you all happy. We wish that we might take you all by the hand and speak the greetings face to face. That would be quite a chore with 16,000 readers so you will have to take the will for the deed. But remember that with us you are a part of a big family for whom we are thinking and working and whom we are trying to help. Good Will to Men is in the air; good will to you is in our thought, and so we are glad to do any work that will help you.

Some of us have had hard pulling during the year and it may seem that there is little to be thankful about or merry over; but after all it's not what we have but how we look at it that makes happiness. When the doctor pitied the small boy who had just had a leg cut off by a street car, the little chap said "Sure it's bad, but it might 'av been me head."

And in the spirit of the holiday season it isn't what or how valuable the gift, but how we give it and how much of ourself goes too, that counts. The wish of Practical Engineer is that you may all have to the full the joy of the thankful and helpful spirit which says, as did little Tim over his meager Christmas bowl of soup, "God bless us every one."

PROSPERITY

Uncertainty as to the policy of the country has without doubt done much to cause delay in the placing of orders for needed machinery. Improvements and development have been held off by the larger corporations partly because of this uncertainty, partly because bonds could not be placed to good advantage. There has been just as much reason for optimism heretofore as there is now, but the business world has refused to act optimistic.

With the certainty of a settled policy comes the releasing of the delayed business, and the past month has seen the ready selling of big bond issues to European and American buyers, the placing of enormous orders for steel, supplies and equipment, and a return of the confidence needed for carrying out new enterprises.

This can mean but one result. The orders cannot be filled without starting up plants and employing workmen, and after the orders are filled, men must be hired to lay the new rails and run the new machinery. The hoarded money must come out of stock-

ings, chests and bank vaults and go on its beneficent way, paying bills and bringing and increasing prosperity.

BEING PREPARED

Getting ready before you begin and the habit of foresight instead of hindsight are important elements in succeeding. To the chief engineer these are part of his duty, and the safeguarding of the lives in his plant is one of the most important applications of foresight. It isn't enough to guard against the recurrence of accidents; he must foresee,—must figure out what danger can possibly arise, and do his best to make it impossible. Some owners seem indifferent about such things and it is necessary that the fearful consequences of "good enough, let it go at that" be brought home to them hard.

A recent awful disaster on board boat in Lake Michigan is a case in point. In the night, on the last trip of the season, an explosion roused the crew, and clouds of steam filling the engine room literally cooked the four men on watch below.

Of course, such a thing hadn't happened before; likewise, of course, it isn't common to equip boilers with automatic stops or distantly controlled valves which will prevent such a fatal result from such an accident. But this is just a case of not being prepared, and shows that in plants such as steamboat engine rooms and basements of buildings, where escape is impossible in case of accident, all available means should be provided for preventing accidents, and for making the resulting damage and injury as small as possible.

It is the business of the engineer to handle his plant as carefully as possible. It is also his business and that of the owner to adopt safeguards at all possible points against all thinkable dangers to life and limb.

EDITORIAL CHAT

Low Pressure Turbines

We, as engineers, are getting mighty economical of our heat units these days, and we ought to. All other parts of the factory are digging away to save a penny cost here and a half cent waste there, so as to make the cost of manufacture cheaper, which means reducing the cost of living to the laboring masses; and it's only right that we in the power department should be careful how we use and waste B. t. u., for that's a saving of cents as well as being sense.

For a long time, the wise ones with the craze for figures have known that there was a lot of kick left in steam which comes out of the exhaust, even when the engine is run condensing; they weren't telling us, however, for fear that we would be worried about it —not having any way to get at that loose energy which was going to raise the general temperature of the United States.

The reciprocating engine is docile and amiable when it gets what it likes to eat; but its insides can't assimilate low grade steam to advantage. The turbine isn't so bloomin' particular and will buzz away with any kind of fodder—and be happy over it.

To say it differently, and to borrow thunder from a paper by Charles B. Burleigh, read before the National Association of Cotton Manufacturers, the work which we get out of expanding steam depends on the number of expansions,—not on the pressure; so we can squeeze as many foot pounds out of a pound of steam working between 15 and 2.5 lb. as between 120 and 15 lb., or from 2.5 to 0.25 lb., as from 150 to 15 lb.—provided only that we have the right kind of squeezing apparatus. But the low-pressure cylinder to take steam at 120 lb. and expand it to 0.25 lb. would have to be 22.5 ft. diameter if the high-pressure was 12 in. diameter; so that a reciprocating engine isn't good for this game.

Now a turbine can be made which acts real satisfied with steam from 15 lb. down to 0.25 lb.—and it gives up just as much work as the engine from which it gets the steam.

The engine, when it works condensing, gives only 30 per cent more power than when non-condensing, while the turbine adds on from 50 to 100 per cent. And another funny thing is that a turbine tacked on the end of an engine not only adds a lot to the power, but actually cuts down the coal used. They did it in Philadelphia, where they added 10 per cent to the power and used 2 per cent less coal,—and the turbines added were not big enough to use all the steam from the engines either. If you want to know how big a turbine your engine would feed, it takes about 33 lb. of steam a kilowatt-hour when working the turbine from atmospheric pressure to 28 in. vacuum.

IT IS SAID THAT 1 hp.-hr. in compressed air can leak through a 1/16-in. opening in 5 min. under 100 lb. pressure.

IN A RECENT DISCUSSION on Industrial Education, Thomas S. Mosby, who is attorney on pardons for the state of Missouri, says that the latest bulletins from Washington indicate that juvenile crime is on the increase, and he lays this to failure of our educational system to give to each boy or girl such industrial training as will give him an occupation. Mr. Mosby pleads for the establishment of vocational training on as important and thorough a basis as the liberal training which has been exploited largely in our common schools during recent years. Samuel Donnelly, who is well known among union labor leaders, has also emphasized the need of such training, and contends that in our public schools we should devote more attention to the workaday side of our great men and to extolling the genius of industry, as well as the beauties of music, art and literature. New York City is to make a start in this kind of work next fall, beginning with a school for boys in the lower East Side, in Manhattan, and with a school for girls in Brooklyn.

ADJUSTING THE CORLISS VALVE MOTION

WITH ONE AND TWO ECCENTRICS

By P. E. Merriam

Preliminaries

BEFORE attempting any adjustment of the gear, a general survey should be made to see that it is in condition to be adjusted. This means that as the engine is turned over by hand, none of the various parts are so long as to interfere with any object and become bent or broken.

It should be seen that the dashpots seat properly, that the springs have sufficient tension to cause the hooks to engage the blocks on the valve crank positively and no more. The steels or blocks should present square surfaces for the engagement of each other. If they do not, they should be turned, or ground square.

It should be noted that the wristplate and its supporting stud are properly marked, as indicated in Fig. 1. On the back of the wristplate 3 marks should be found and a mark on the supporting stud. The central mark on the wristplate when it is in line with the mark on the stud indicates that the wristplate is in its central position of travel. When moved so that 1 of the marks on the side of the center marks, coincides with the center line, it shows the wristplate to be in its extreme position in that direction, at which time the eccentric is on its dead center. These marks are not always on top as shown in Fig. 1; sometimes they are on the side; that makes no difference as long as they are equally spaced as shown.

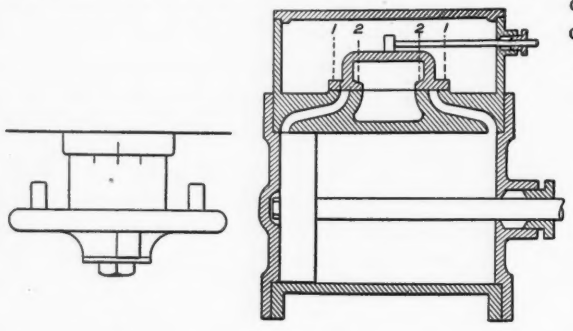


FIG. 1. PROPER MARKINGS ON WRISTPLATE HUB

FIGS. 2 AND 3. RELATION OF 4 CORLISS VALVES TO THE 4 EDGES OF A D SLIDE VALVE

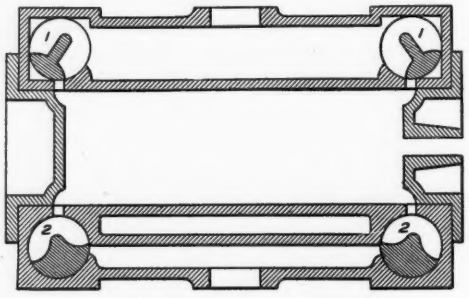
Centering the Rocker Arm

Should an engineer desire to know how these marks are laid out the following may prove of interest. First, with the eccentric loose on the shaft turn it into a vertical position either above or below the horizontal center line of the shaft; the rocker arm should be vertical. Drop a plumb line through the centers of the pins, to which the eccentric rod and hook-rod are attached to the floor. Next turn the eccentric to one of its dead centers, and drop a plumb line through the pin to which the eccentric rod is attached to the floor; then turn the eccentric to the other dead center and again plumb to the floor. Measure from the center mark to each mark on each side; and divide the difference between the 2 by changing the length of the eccentric rod.

When the rocker arm is plumbed, catch the hook-rod on its stud in the wristplate, then plumb the rocker arm and make a mark across the wristplate and its supporting stud. Then turn the eccentric to its dead center and make a mark on the wristplate in line with the mark on the supporting stud. Repeat this for the other mark on the wristplate.

Corliss and D Valves

Before considering the adjustment of the valves, consider the similarity of the Corliss gear and the common D slide valve. Fig. 2 shows the slide valve



in which the events of admission, cutoff, release and compression are controlled by 1 valve. The outside edges 1, 1, are the steam edges, and control the admission and cutoff for their respective ends. The inside edges 2, 2, control the time of the exhaust opening and compression.

In the Corliss design, Fig. 3 the valves 1, 1, take the place of the steam ends, Fig. 2, and regulate the admission and cutoff for their ends; the valves 2, 2, govern the release and compression, corresponding to 2, 2, in Fig. 2. While in the case of the slide valve, all events are performed by 1 valve, in the Corliss engine each event is capable of independent adjustment, which is a decided advantage.

Valves Opening Outward and Inward

With the Corliss, when the lines on the valve and on the seat are in line, the edges are in line, neither open nor lap the port but have just closed the port. To ascertain whether the steam valves turn inward or outward to open the port, the type of valve gear must be considered. When the type shown in Fig.

4 is used, the bottom of the steam valve turns inward to open. This means that the line on the steam valve moves toward the center of the cylinder as seen in Fig. 4 to open the steam port. When the gear shown in Fig 5 is used, the steam valve turns outward or away from the center of the cylinder to open the steam port; whichever type of gear is used the exhaust valve always turns away from the center to open the ports.

The arrangement of rocker arms should be noted. As to the various effects of a direct and indirect connected valve motion, the reader is referred to page 57 of the July issue of Practical Engineer. In the majority of cases the direct connection between eccentric and rocker arm and from the rocker arm to the wrist plate is employed for single eccentric gears. For double eccentric gears, to get a quick opening of the steam valve, the hook-rod is connected to the wristplate either above or below the horizontal center line, but the steam radius rods are below the center line, thereby making the wrist plate, in effect, a reversing rocker, with the steam eccentric following the crank, as will be seen later.

Another precaution is to take up all lost motion in the several bearings of the valve gear, and remember, when turning the engine, always to turn it in the direction it is to run, in order to take up all lost motion in the same way.

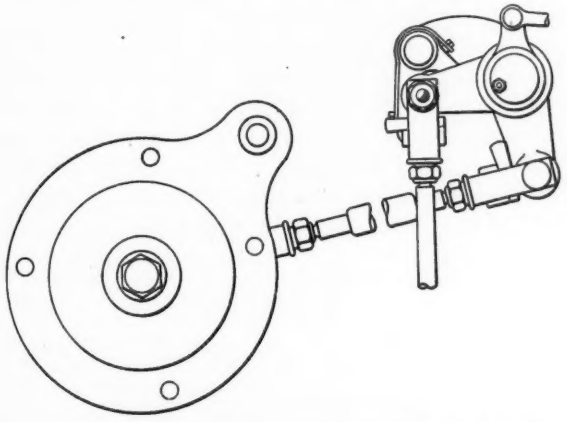


FIG. 4. HOOK GEAR OPENING STEAM VALVES INWARD; STEAM COMES OVER OUTER EDGE OF VALVE

Adjustment of Valves, Single Eccentric Gear

First, place the governor on the safety pin, Place the crank on the head end dead center; the other dead center would do as well, only it seems to come handy to have the crank on the head end center.

Loosen the eccentric on the shaft, and turn it from one of its dead centers to the other, and by adjusting the eccentric rod, cause the rocker or carrier arm to swing equal distances on each side of the vertical position, Fig. 6. Then connect the hook rod to the wristplate, and adjust its length so that when the eccentric is turned from one dead center to the other, the wristplate travels equal amounts each way from the vertical.

Hook-Rod and Wristplate

If there is no provision for adjustment of length in the hook-rod, as is the case on some of the older engines, cause the wristplate to travel to its marks by the adjustment of the eccentric rod, regardless of the travel of the rocker arm.

Place the wristplate in its central position, and secure it by placing a piece of cardboard between the end of the supporting stud and the washer at the end. With the wristplate secured, proceed to lengthen or shorten the radius rods to give the steam valves their proper lap. A study of Figs. 4 and 5 will show in which direction the steam valves turn to open the ports and how the marks in line with the edges of the ports should stand with reference to the marks on the valve to give the valve proper lap.

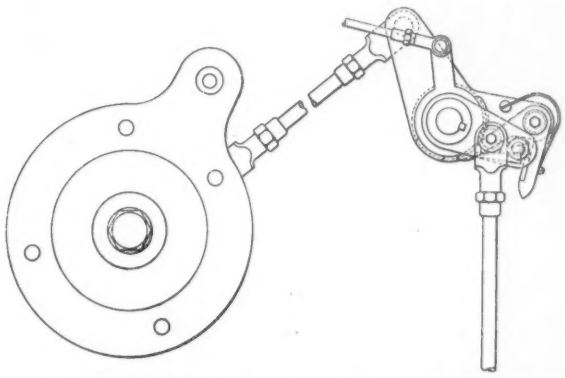


FIG. 5. HOOK GEAR OPENING STEAM VALVES OUTWARD; STEAM COMES OVER INNER EDGE OF VALVE

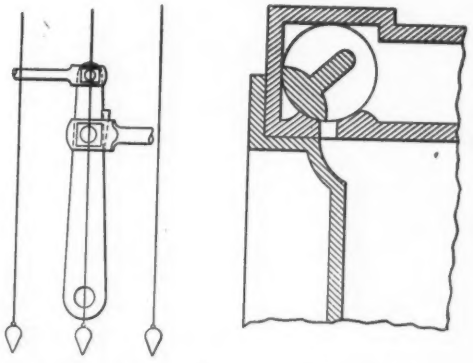


FIG. 6 FIG. 8

FIG. 6. ROCKER ARM IN CENTRAL POSITION

FIG. 8. STEAM VALVE WITH NEGATIVE LEAD

Adjusting Lap

The accompanying table gives the proper lap and trial compression for various sizes of engines. While the values given can be departed from more or less, an engine will be found to run better, from all points of view, when the values in the table are used, be-

cause the engine was designed for these conditions. In the case of a 20-in. cylinder, the steam lap as per table is 3/8 in.

To lap the steam valves this amount, adjust the steam radius rods from the wristplate to each valve. The exhaust valves should be given a lap of 1/16 in., which is secured by adjusting the radius rods.

Now, with the crank on the dead center, turn the eccentric ahead on the shaft in the direction the engine is to run, until the head end steam valve shows that the mark on the valve and the mark for the port edge are separated 1/32 in. Then secure the eccentric to the shaft. Turn the crank to the other dead center and see whether the steam valve on the crank

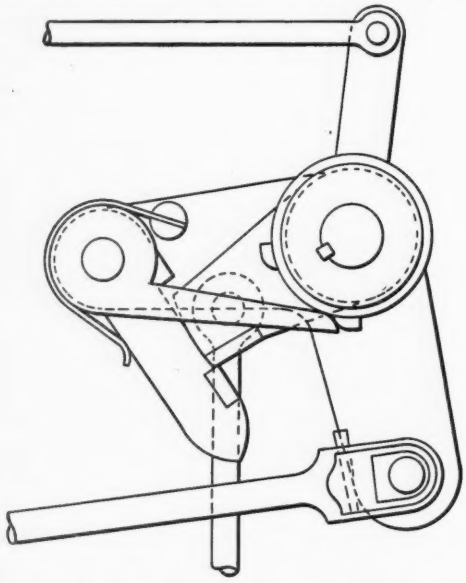


FIG. 7. DETAIL OF SAFETY CAM AND ADJUSTMENT

end has the same lead. If not, adjust the radius rod until the lead is correct. Now turn the wristplate to one of its extremes of travel and adjust the length of the dashpot rod to just engage the steam hook, with a clearance of about 1/16 in. when the dashpot is seated. Turn the wristplate to the other extreme of travel, and repeat the adjustment.

Adjusting Compression

Turn the engine until the piston is within 2.5 in. from the end of the stroke, and see that the exhaust valve has closed the port for the cylinder end, which the piston is approaching. Repeat this for the other exhaust valve.

Governor Adjustment

Now mark off 25 percent of the stroke on the guide and turn the engine until the crosshead comes up to the line. Then raise the governor balls into running position and block them there. Adjust the knockoff or cam rods from the governor to the steam valves until the steam valves just trip.

Remove the blocking from the governor and let the governor down to its lowest position. Then turn the wristplate to its extreme of travel, and see that the safety cam is in position to keep the steam hooks from picking up the steam valves, as seen in Fig. 7. If they are not so placed, loosen the set screws and move the cam blocks downward until, when the wristplate is moved to its extremes of travel, the valves are not opened.

Raise the governor to its highest position and block it there. Then turn the wristplate to its extremes of travel and see that the steam valves are not opened. To secure this result slacken the set screw in the collar on the governor spindle and raise the collar until the balls come up so high that the valves are not opened.

LAP AND TRIAL COMPRESSION FOR CORLISS ENGINES

DIAM. OF CYLINDER IN INCHES	STEAM LAP IN INCHES	STEAM LEAD IN INCHES	EX. LAP IN INCHES	TRIAL COMPRESSION IN INCHES
10 & 11	1/8	1/64	1/16	1 3/4
12 & 14	5/16	1/32	"	2 1/4
16	1/4	"	"	2 3/8
18 & 20	3/8	"	"	2 5/8
22 & 28	7/16	3/64	5/32	2 7/8
30 TO 34	15/32	1/8	3/16	3 1/2
36	1/2	"	7/32	4
40 & 42	9/16	"	1/4	"
44 TO 48	5/8	5/64	5/16	"

As a final check on the valve adjustment, after the engine is running with its load, apply the indicator and be governed by its diagram.

Double Eccentric Gear

In this type of valve motion there is 1 eccentric to move the steam valves and another eccentric to move the exhaust valves, the object being to secure a longer range of cutoff and adjustment of the release and compression, regardless of the steam valve functions, which is not possible to so great an extent with the single eccentric.

In the double eccentric gear, when the wristplate is central, the steam valves are open, or have negative lead, as it is termed.

Having equalized the travel of the rocker arm and the wristplate, place the wristplate central with the valves hooked up. Then adjust the steam radius rods so that the steam ports are open about 0.25 of their width, which will be shown by the marks on the valve and on the ports, being about 0.25 of the width of the port apart. The other parts of the gear are adjusted as in the case of the single eccentric motion, except the steam eccentric when giving the valves their lead.

As the valve connections from the steam valves are usually below the horizontal center line of the wristplate, the wristplate becomes a reversing rocker arm, and the steam eccentric is turned ahead on the shaft in the direction of rotation until the valve has the proper lead. This position will be found to be behind the crank.

The exhaust eccentric is turned ahead to give the necessary compression, having first equalized the travel of the wristplate and given the valves the required lap, as per table, when the wristplate was in its central position.

WHAT PACKING SHALL I USE?

By W. E. Sanders

THIS is a question which frequently presents itself, not only to the purchasing agent or superintendent, but also to the master mechanic, and most frequently to the engineer. In some plants, more particularly the very large ones, the choice of packing is settled by the higher authorities, but for the general run of plants the question of packing comes back to the engineer, who either purchases it himself or recommends the kind of packing that he wishes to use.

The answer to this question is not quite so easy as one would at first think. An engineer may have used a certain kind of packing from his boyhood and he is very slow to appreciate the fact that advances have been made in packing, as well as in engines, and that while the packing which he has always used gives good results, yet some other packing of later invention may give him much more satisfactory results and, still further, be more economical.

Besides, the number of packings is almost countless. Some of them differ widely from each other in form and construction; some of them differ widely in cost. Whether it is cheaper in the long run to use a packing which costs less at the start, or whether it is better to use a higher priced packing, is a question that involves not only experience but an investigation into the principles of packing itself. It may be well before deciding what packing to use to consider the principles of the packings on the market, and then, secondly, to consider which packing is best adapted to any particular case.

Object of Packing

The general mission of packing is to prevent a leak of any fluid, which may be liquid or gas, from passing through a joint from the inside where it is under pressure to the outside where the pressure is merely atmospheric. This may be a comparatively simple case as when gaskets are used to prevent steam from escaping at a joint, or it may be quite a complicated case, as the use of packing on piston rods for steam or gas.

We will take up first the principles which are involved in successful packing and then we will take up the different methods which are employed to apply these principles, and lastly we will classify various conditions of packing and apply these methods to them.

Principles of Action

The principles of packing can best be explained by illustration, and a good illustration is shown in the manufacture of Portland cement by the wet process where a mixture of clay and marl in the form of a finely pulverized mud is kept in tanks before being fed to the kilns and is known as "slurry." The moisture in this slurry may vary from 45 to 70 per cent. It is often necessary to measure these tanks by means of a rod of wood, and of course when the rod has been plunged into this slurry it will be drawn out with the slurry sticking closely to it.

Naturally, the one drawing the rod out will strip the slurry off with his hand. If the slurry runs 70 per cent moisture, this is an easy operation and a mere passing of the hand over the rod will clean it. If the moisture runs down to 60 per cent, the operation is a little more diffcult, and a tighter grip must be had on the rod, for the slurry at this point is very stiff and clings to the rod. If the moisture gets down to 45 per cent it will probably be necessary to move one hand after the other, letting both hands to the work of cleansing the rod.

This illustrates exactly the operation of packing in preventing steam from going out of a cylinder. The rings of the packing that are in the stuffing box act as do the fingers on the slurry rod referred to above. If the pressure in the cylinders is low, there is very little need of any tight grip on the rod and the grip produced by the packing rings may be merely nominal. If the steam pressure is higher, it will be necessary to grip the rod tighter in order to prevent the steam from going out. If the steam pressure is quite high, it will be found necessary not only to grip the rod more tightly, but also to increase the number of grips.

For this reason 1 ring of packing would not do, but there must be 4 or 5 rings of packing and all must grip the rod tightly. To sum the matter up, it is necessary in holding back steam or any gas or liquid to raise the pressure on the rod, as the pressure from within increases, or increase the number of grips on the rod, and these points we must remember whenever choosing a packing.

Kinds of Packing

We can now classify the different packings in accordance with the principle on which they work and by which they obtain the necessary grip on the rod. The simplest form, and the earliest form as a matter of history, is the plan which we use today for globe valves, and that is, putting in a soft packing and pressing down upon it with the gland. If the packing leaks, we compress it still tighter with the gland. If the pressure is low, it is not necessary to compress the packing very much. If the pressure is high, it has to be compressed very considerably. As a globe valve stem is not in motion most of the time, there is no particular steam economy, or less of economy in using this particular form of packing, but on a piston rod which is moving the matter is quite different

When packing is placed in a stuffing box and the gland screwed down, the pressure which results is sometimes far more than the engineer thinks. A little mathematics will show this. If there are two stud-

bolts each with 8 threads to the inch and a force of 1 lb. is used on these, at the end of an 8-in. wrench, the total pressure will be about 125 lb. Even if the pressure were not so much as this it is very clear that it is too great a pressure to which to subject the packing. The grip on the rod may become so intense that the rod is actually immovable. An example of this, which is probably a bit of experience with everyone, is the setting up of a packing on a service pump, and it is well known that the packing on a service pump can be set so tightly that it is impossible for the pump to move itself. This is because of the intense friction on the rod, and it is this friction that wears away pump rods.

A rough idea of the amount of work done could be shown by taking a pump rod and placing it in a lathe and filing it down to the same thickness as when worn away. This is a crude illustration but it brings the matter clearly to one's appreciation.

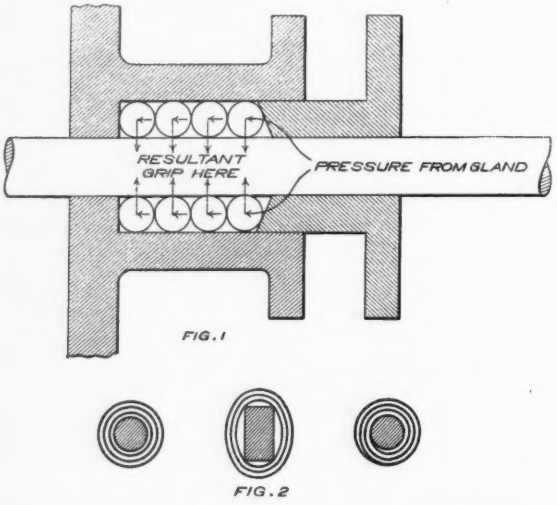


FIG. 1. PRINCIPLE OF "MONKEY-WRENCH" PACKING

FIG. 2. TYPICAL CROSS SECTIONS OF MONKEY-WRENCH PACKINGS

Packing of this type include the ordinary square flax, round core and gum core packings and what is commonly known as "red core spiral." The round and flat gum core packings are made by braiding successive sheaths about a flat or round gum core. These packings form about the cheapest steam packings that are on the market. They depend entirely for their success on a pressure from the gland and for that reason we class them as "monkey-wrench" packing.

As the pressure from the gland is generally much stronger than necessary, there is produced on the rod an unnecessary friction, and as this friction is on a moving rod there is done at every stroke a certain amount of work that is unnecessary, which work is required simply to pull the rod through the packing. This, of course, requires steam and steam requires coal and there is actually consumed a certain percentage of the work from the engine in overcoming the excess friction caused by the packing.

Sometimes this packing is made by wrapping a piece of duck around a gum core, but the principle of application is the same and from an economical standpoint this class of packing, which was the class first brought out, is really the poorest, the friction almost invariably being excessive and the consumption of the steam on account of the packing very large.

Moisture Packing

A second class of packing, which depends partly on the monkey-wrench and partly on another principle, is known as "moisture packing." Flax packing might be classed under this head. These are packings that require moisture to expand them. The best example is the case of flax and duck, sometimes made up with a rubber back, sometimes with the duck passing completely around the back of the packing. In this case the flax swells up with the moisture and does the packing, while the duck stands the wear and tear.

This is more satisfactory than the first class. It has been used for years and years by old engineers.

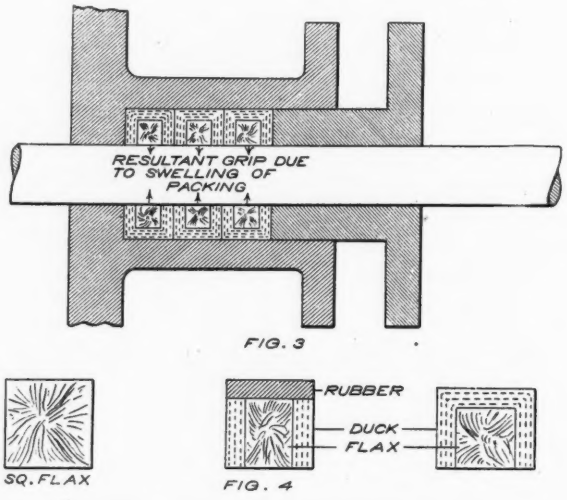


FIG. 3. PRINCIPLE OF MOISTURE PACKING

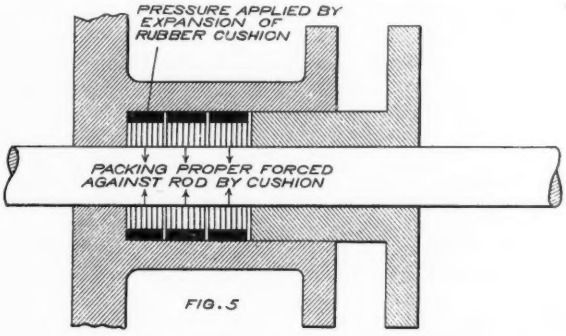
FIG. 4. TYPICAL CROSS SECTIONS OF MOISTURE PACKINGS

It is not a packing, however, that would be available where the steam was entirely dry when it reached the box, or where it was superheated. Of course steam that is dry when it reaches the cylinder is not dry when it reaches the box, or when it enters the box, for the reason that the box is more exposed and consequently is much cooler and the rod is one-half the time out in the cool air, and since as high a temperature as the live steam cannot well be maintained, the steam in the box will be moist. If the steam is originally superheated, however, it may get in the box as dry steam, in which case it is very hard on a packing that requires moisture to cause it to swell and thus produce the requisite grip on the rod.

Expansion Packing

A third principle which is used is that of a packing which expands but not from pressure from the gland. This expansion is generally caused by the expanding of some material used as a cushion, under the influence of heat. The material almost universally used is rubber. Rubber when heated will expand, and if this is used in connection with the packing, it will when heated force the packing against the rod and give an easy cushion effect on the rod, which is entirely independent of the gland.

Since this is true, there is absolutely no reason for the engineer to use a monkey-wrench, and consequently there is no opportunity to force the packing too tightly against the rod and produce undue friction. It is therefore a packing that is more economical, so far as consumption of steam is concerned, since there is a lighter load on the engine due to the decrease in the friction of the packing on the rod. An expansion packing is a better packing than that which depends on pressure from the gland, such as a monkey-wrench packing, being not only more economical of steam, but also easier on the rod.



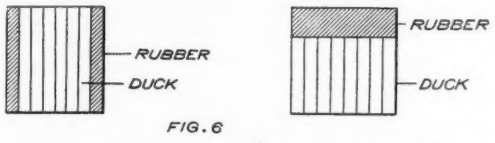


FIG. 5. PRINCIPLE OF EXPANSION PACKING

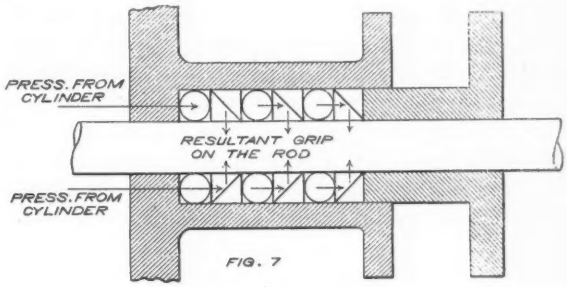
FIG. 6. TYPES OF EXPANSION PACKING

This same result is produced in certain metallic packings by the use of springs, but as metallic packings form a subject entirely by themselves, this article will treat only of the nonmetallic packings.

Automatic Packing

The fourth class of packing depends, not on pressure from the gland, and does not depend on any expansion due to heat or due to the swelling of any substance, but does depend on pressure from the cylinder. This packing is an automatic packing commonly called "Diagonal" packing, because it contains wedges which are formed by cutting a square section diagonally. This packing is the most economical of all in steam consumption.

Referring to the first principle for packing, it is necessary to grip a rod in proportion to the pressure which is trying to force its way out. It is evident then that on an engine which uses steam expansively there is no necessity of preserving the same grip on the rod during expansion and exhaust as there is during compression and admission. If, then, a packing can be used in which the grip on the rod varies with the pressure in the cylinder, it is the most economical packing, and for an engine that uses steam expansively there is still a further saving, since the grip on the rod will decrease during exhaust and a saving will be obtained during that part of the stroke at least.



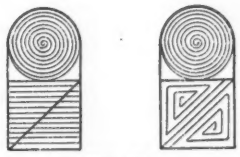


FIG. 7. PRINCIPLE OF AUTOMATIC DIAGONAL PACKING

FIG. 8. TYPES OF AUTOMATIC DIAGONAL PACKING

There are a number of diagonal packings, differing from each other in the form and shape of wedges, but all of them depend upon the same fundamental principle that the pressure from within the cylinder will force the wedge next to the rod in toward the rod, and, of course, that means that the grip which it has on the rod will vary with the pressure forcing it, in other words, with the cylinder pressure.

SULPHATE OF LIME is the worst scale forming constituent of boiler feed water. To test for this, fill a test tube to about 1.5 inches in depth with the water to be tested, and then add a little chloride of barium. If a white precipitate is formed and it will not redissolve when you add a little nitric acid, sulphate of lime is present.

STILL FURTHER UPWARD climb the pinnacles of New York. Now it is the tower of the Metropolitan Life Building, which is to overtop that on the Singer Building by 46 ft. This latest spire will be 75 by 85 ft. with a height from sidewalk to tip of 658 ft. and weight of 37,333 tons. There are 1,400 windows in the 48 stories. To carry the great weight and wind pressure, the steel columns are remarkably large, being 38 in. square at the base, and weighing 1 ton per foot.

LETTERS FROM ENGINEERS

Send us descriptions of ways of doing new things, and new ways of doing old things. Rough pencil sketches and letters are all right; we will fix them up for the printer. All accepted contributions will be paid for when published.

Feeding Compound to Boilers

Nearly all engineers are troubled more or less by the deposit of scale in their boilers. In some cases this is in the form of mud settling to the bottom where it remains until washed out with the hose. In other cases the scale forms a hard coating on all parts of the surface exposed to the water.

Water may be clean to all appearances, yet contain a good deal of sediment, and as the boiler evaporates

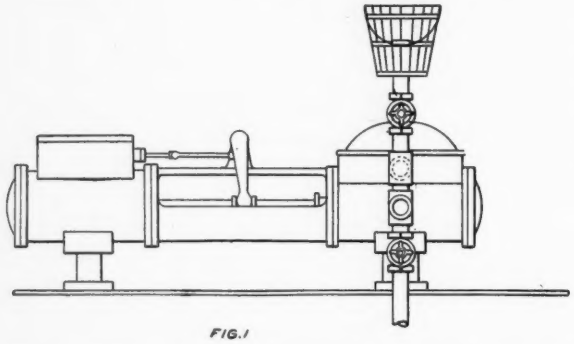


FIG. 1. METHOD FOR INTERMITTENT FEEDING OF COMPOUND

a large amount in a short time a few grains of sediment carried in with the feed water at intervals will in a short time accumulate quite a deposit. Frequent use of the blowoff will remove the soft sediment but will not take care of the hard scale, and oftentimes some of the soft sediment will not be taken care of by the blowoff.

This is not an argument against the use of the blowoff, which should be done frequently, and at times when the circulation is quietest, such as in the morning or during the noon hour when the deposit is likely to be settled to the bottom of the boiler.

In order to keep out the hard scale some form of boiler solvent or compound must be used regularly, the kind to use being determined by chemical analysis of the water to be treated. For the best results, this compound should be introduced regularly and systematically instead of at the infrequent intervals of boiler cleaning. If introduced only when the boiler is shut down, not only are the periods between treatments too long, but the compound is largely blown out of the boiler in the course of ordinary running, long before a new charge is introduced.

To avoid this condition the best method is the use of some form of continuous feeding apparatus so that the compound can be put in at any time and in any quantity. Small quantities injected daily accomplish the best result and avoid any possible cause of foaming. It is better to put in a pound a day.

Usually some means of introducing the compound into the feed water as it goes to the boiler feed pump is adopted. Figure 1 shows a method frequently seen, in which a tee is put on in place of an ell on the suction pipe to the pump, carrying the pipe up above the pump and inserting a valve above which an old pail is placed as shown. When using this apparatus, it is necessary to put in the charge intermittently rather than continuously, that is, a certain amount of solvent must be pumped in while no water is being drawn and then the water allowed to feed with the connection to the pail shut off. This necessitates a valve in the suction pipe below the tee.

This device is, however, unsightly, and the arrangement shown in Fig. 2 is to be preferred, both for ap-

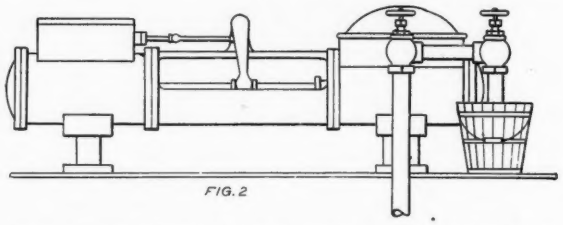


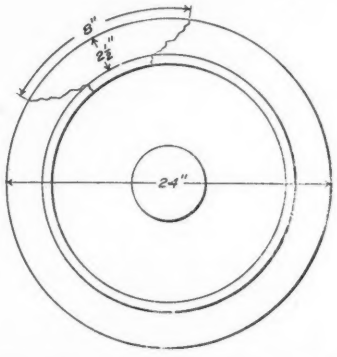
FIG. 2. ARRANGEMENT FOR CONTINUOUS FEEDING OF COMPOUNDS

pearance and because it makes it possible to feed the boiler compound continuously. In Fig. 2 a branch is carried to one side of the pump and then down toward the floor, using an angle valve in place of the ell. The compound can be dissolved in a pail and on the floor under the angle valve, then by opening the angle valve slightly a small amount of the compound may be sucked in with the feed water continuously, thus mixing each pump full of water with its proper proportion of compound.

One arrangement which I have seen work and which was very satisfactory consisted of a sink arranged so that the outlet could be stopped up and the compound mixed in the sink and a suction pipe from the injector extending into the sink so that the injector could feed the compound to the boiler. In this plant there was no pump and it was, therefore, necessary to introduce the solvent intermittently instead of continuously. The whole rig was constructed of brass pipe in order to avoid any possibility of corrosion or stopping up C. H. T.

Broken Piston

I have had a little accident with my engine about which I would like some advice. It is a 24 by 48-in. Watts-Campbell engine of Corliss type running at 76 r. p. m. and 120 lb. pressure. One morning I started up and everything was all right until 7:30, when the



BROKEN PISTON SHOWING PIECE MISSING

engine started to pound very hard. I shut down at noon, took off the cylinder head and pulled the piston apart, and when I took the bull ring out I discovered a piece out of the top of the piston about 8 in. long and 2.5 in. wide.

I would like to know what readers think would cause that piece to come out. The piece has not been found E. H. S.

Feed Pipe Location

In regard to W. Westerfield's Feed Water Arrangement, I beg to differ. I think there should be a law against feed pipes going lower than the top row of tubes, for in these days there are many feed pipes made of iron with cast-iron elbows and I have seen boilers with 3 and 4 elbows on the boiler side of the check valve.

Now we all know the life of an iron feed pipe is short; I have known them to fail in 2 yr., to say nothing of the cast-iron fittings. In case the pipe or elbows give out suddenly, it would take about 2 minutes to blow out all the water in the boiler if the feed pipe went down to the bottom. In fact I would rather someone would open wide my blowoff unbeknown to me, as it would cause less trouble and make less mess.

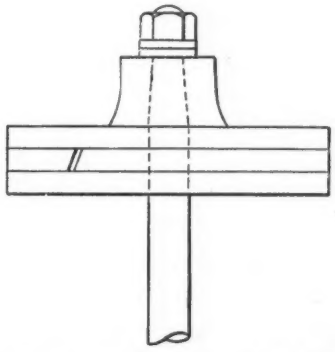
I see by the cut that the blowoff end comes over the fire-plates. Now every boiler gets cold feed water once in a while, though we don't mean to have it; and it strikes me that there would be some leaking girth seams, if this scheme were carried out. If the feed pipe goes within 2 ft. of the back head with an elbow looking down 3 in. above the top row of tubes, and if any pipe rusts out or cast-iron fittings break on the feed line inside the check valve, we will be much safer and run no risk of spoiling the boiler, to say nothing of the fireman. S. B.

An Emergency Piston

I am employed in a large plant where tandem compound engines are the fashion, and among the rest is a 9 and 15 by 24-in., running 75 r. p. m., and furnishing power for a paper machine. About 9 p. m. one night, the high-pressure piston went to pieces for some reason at present not accounted for. Well, it looked like a 10-day vacation for the crews of that machine, all right, but the chief was called, and after a hasty inspection, decided to try to run with the low-pressure cylinder.

The high-pressure cylinder head was removed and the pieces of the broken piston taken out, leaving the end of the piston rod afloat, so to speak, as the entire piston was smashed. The head was then replaced and the engine started and run 22 hr. until the week ended, the only bad result being a bent high-pressure rod, which was easily straightened, and a slightly increased fuel consumption.

This accident happened at about 9 p. m., Friday night, and the engine was at work again 2 a. m. Sat-



THE EMERGENCY PISTON MADE FROM A PIPE FLANGE

urday. On Sunday the piston rod was taken out and straightened, and in the meantime the chief had found an extra heavy blank flange, 2 in. thick, which he bored to fit the taper on the end of the high-pressure piston rod. He then turned it down to the right diameter and grooved it to take the packing rings, and this temporary piston was put on with a heavy washer on each side to take up what lost motion there was on the taper end, and the engine was started on time the next day, only 5 hr. time being lost. It is running as I write this; there was no change made in the valve setting; the boiler pressure was 140 lb., and was not reduced. W. E. Chandler.

Effects of Compression

Replying to A. R. M.'s query, concerning his engine, indicator diagrams from which appear on page 50 of your September issue.

Apparently A. R. M. has his data twisted, only he hasn't, and his engine is doing what any sensible engine ought to do under the circumstances. Hatching the expansion toes of the cards in the 2 figures will make the facts clearer, I think.

When studying a compression line, we are quite apt to forget that there was steam expanding on the other side of the piston when the compression line was being made, and that one may obliterate the effect of the other.

It is evident that we are dealing with a 4-valve engine of the releasing gear type and that the exhaust valves close at the same point in the stroke regardless of variations in the load.

Notwithstanding all this, the effective compression is greater in Fig. 1 when the terminal pressure on the

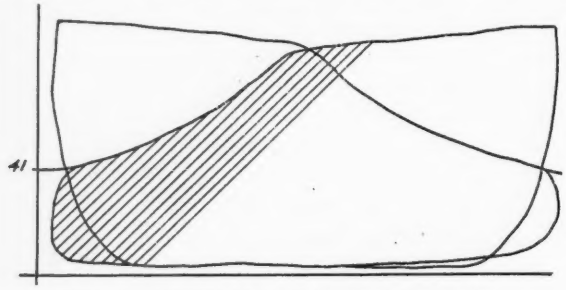


FIG. 1. HEAVY LOAD, NOISELESS RUNNING

opposite side of the piston is about 40 lb. than in Fig. 2 where the terminal pressure is only 15 lb. (A 60 spring has been assumed).

I would try closing the exhaust valves a trifle earlier.

Who can tell us why more compression is realized in Fig. 1 than in Fig. 2, assuming a constant exhaust closure and the same back pressure?

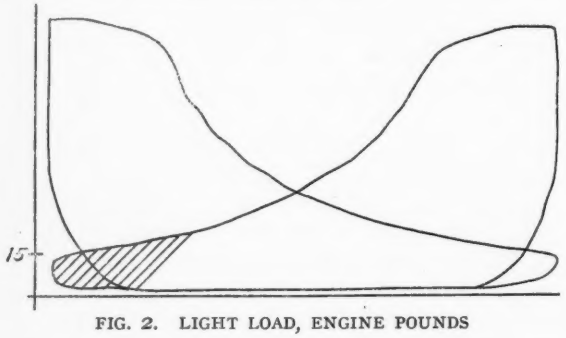


FIG. 2. LIGHT LOAD, ENGINE POUNDS

It will be noted that the compression curves have a more vertical slant in Fig. 1 than in Fig. 2.

E. G. Tilden.

Setting the Expansion Valve

An article in the July issue, entitled Setting the Expansion Valve, attracted my attention on account of the erroneous opinion apparently held by the writer. He says, "Too wide an opening will allow the liquid to pass through without evaporating," and again, "The passage of unevaporated liquid may sometimes be detected by the ear." It is evident that the writer is of the opinion that it is not good practice to allow liquid ammonia to pass the expansion valve.

I am aware that this is the opinion of a great many operating engineers; I am also aware that I am not advancing something new when I say that it is desirable to allow liquid ammonia to pass the expansion valve.

Ammonia was chosen as a refrigerating agent because of its low boiling point and comparatively high latent heat; also because of its low vapor tension, that is because of its high temperature at moderate pressures . At 120 lb. gage pressure anhydrous ammonia has a temperature of 70 deg. F. By circulating water of 60 or 65 deg. F. over a coil of pipe containing anhydrous ammonia gas at a temperature of 70 deg. and a pressure of 120 lb. gage, it is plain that some of the heat in the ammonia will be carried away by the water. If a constant pressure be maintained and the water circulation continued, for every heat unit that is removed a given amount of ammonia gas will be condensed and will become liquid.

To condense 1 lb. of ammonia gas at a pressure of 126.5 lb. gage it is necessary to remove 508 B. t. u.

The specific heat of liquid ammonia is variously stated from 1 to 1.22; suppose we say 1.1; then, to reduce 1 lb. of liquid ammonia from a temperature of 75 deg. F., which is the temperature corresponding to a pressure of 126.5 lb. per square inch as given to zero would require the expenditure of $75 \times 1.1 \times 1 = 82.5$ heat units. This is to reduce the temperature of the ammonia,—not the temperature of the room, nor the temperature of the brine, the temperature of the liquid ammonia, only.

This is done in everyday practice by opening the expansion valve and allowing the liquid ammonia to pass from a higher to a lower pressure, say from 126.5 lb. to 15 lb. gage, from a temperature of 75 deg. to 0 deg. F.

On reaching the lower pressure, the liquid will give up 82.5 B. t. u. and 82.5/508 of the pound of ammonia liquid will evaporate, become gas.

Now we have the pound of ammonia beyond the expansion valve; 82.5/508 of it has evaporated in reducing the temperature of the whole to zero and 425.5/508 is still in liquid form.

Now, as to the question, is it desirable to have it pass the expansion valve in liquid form? Suppose that the freezing coil is in a cold storage room the temperature of which is 20 deg. F., the temperature of the ammonia being zero, it will take heat from the room through the freezing coil. Every heat unit it takes from the room will cause a certain amount of the liquid to evaporate; when it has taken 425.5 heat units, all the liquid will be evaporated, because $425.5 + 82.5 = 508$ B. t. u. which is latent heat of liquid ammonia at 126.5 lb. pressure.

If we don't allow the liquid to pass the expansion valve we don't get the benefit of its latent heat properties, one of the very important properties for which ammonia was chosen a refrigerating agent.

John Nash.

Adjusting an Air Compressor

I am in charge of a Laidlaw-Dunn-Gordon air compressor of cross-compound condensing type and 1100 cu. ft. a minute capacity. I have been here but a short time, and when I took charge I found a lot of things not just right. The main shaft does not seem to be in line, and they tell me that the erecting man, when he put the plant in, did not run a line through the cylinder, but lined the shaft from the outside of something. The shaft has been bothering all along.

Last week, while I was in a different part of the works, an assistant tried to take up the wedges on the main boxes, and they got so hot that he called me. We had to let off until very slack to keep from ruining the babbitt. The wedges are taken up by a bolt head running up through the cap to the main bearing, and I would like to know if there is any way I can tell without taking the piston out whether the shaft is in line, and if there is any way to get those wedges set before putting on the cap to the main bearing.

D. E. C.

Dynamo Reversal

On several occasions I have read articles in Practical Engineer on the subjects of running of direct current machines in parallel reversal of polarity, etc., which have been of much interest. The following relation of an experience of mine may be of interest to other readers:

The figure sketch shows the connections of two 500-kw. 250-volt direct current machines which had just been set up and connected to the switchboard.

I noticed when the switchboard was unpacked that there was a plug switch in each of the 2 plug receptacles P_1 and P_2, but paid no particular attention to them at the time.

When we were about to build up the voltage of machine No. 1, I thought of the 2 plug switches and immediately pulled out the one on the panel of No. 2 machine. Machine No. 1, however, had been running at normal speed for some time with almost all the field resistance R_1 cut in, and the voltmeter V indicated about 10 volts. No. 1 built up correctly, but when No. 2 was speeded up and plug switch P_2 placed in the receptacle, it was found that the fuse D_2 in voltmeter circuit had blown and voltmeter V failed to indicate. When the fuse was replaced, the voltmeter indicated but showed that the polarity of No. 2 was reversed with respect to No. 1 machine, as the pointer went back against the stop.

What had caused the reversal was readily apparent. The 2 plugs being in when No. 1 showed 10 volts, short circuited each machine through the other, with the result that enough current passed through the series coil of No. 2, through voltmeter bus connection, to reverse the field magnetism. The path of current was as follows: from + terminal of No. 1 through P to + voltmeter bus to P_2, through S_2 in reverse direction to A_2, to — terminal of No. 2, to — voltmeter bus and back to — terminal of No. 1 machine. Little or no current would flow through F_2 and R_2 because of its high resistance compared with S_2 and A_2.

We had no load available and No. 2 was re-reversed in about 2 minutes as follows:

The field resistance on No. 1 having previously been cut in so as to cut down the voltage of No. 1, the brushes on No. 2 were raised, equalizer switch closed, circuit breakers closed and switches B and B_2

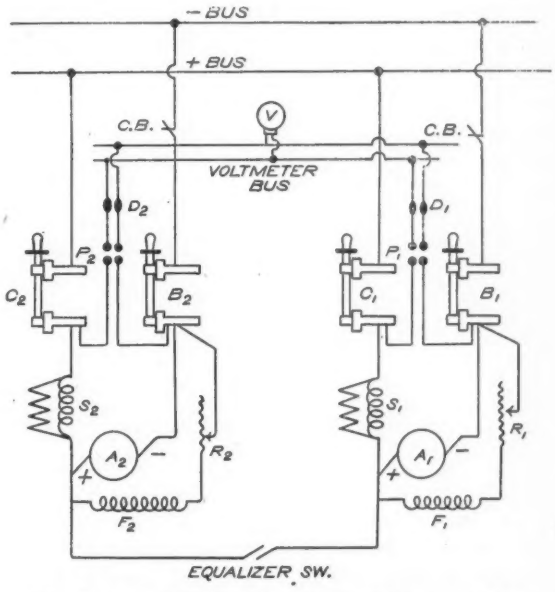


DIAGRAM OF CONNECTIONS FOR 2 DIRECT-CURRENT MACHINES IN PARALLEL

closed. Field resistance R_1 was then cut out and as the voltage of No. 1 was built up it was impressed across the terminals of F_2 in such a manner as to produce a field magnetism in the proper direction, No. 2 machine being idle. This machine immediately built up correctly when brushes were lowered and the machine speeded up.

E. S. H.

Steam Hammer Trouble

In the November issue of the Practical Engineer, A. J. C. says that he has trouble with a steam hammer. I was employed around a plant for about 3 years, where the 3 steam hammers gave the same kind of trouble, and as we were working day and night, Sunday was the only day for repairs, and sometimes all 3 hammers were down and out.

After some experimenting, I found the cause to be in one hammer, that the guide on one side was not adjusted right, that is, it was not the same distance from the center line of the piston rod as the opposite guide, hence, caused the piston to move to one side, cutting the cylinder. By dropping a plumb line through the center of the cylinder, after removing the piston, ram and die, I also found that one leg of the hammer had settled somewhat, throwing the cyl-

inder out of plumb, which of course caused the die to swing to one side and wear the guide.

The side was jacked up, lines put under the leg at the outer edges, everything replaced, and by hard work, and lots of lurid language by my helpers, we had her going again on Monday morning. By using plenty of graphite in the oil and oiling very often for the first few days, we had no more trouble with this hammer.

Sometimes the packing was at fault, as the hammer driver would tighten up too much on the gland and not pump enough oil; the piston would cut the packing on one side and the hammer would groan.

By watching your men you can often see where the cause is. I have had some trouble with a hammersmith who insisted on using one side of the die only, and as the heat from the billets would heat one side more than the other we had 2 piston rods break right at the ram, after changing the dies about and telling the smith to work in the center, that was stopped. Keep your eyes open and you will find the cause more often with the men than with the hammer.

R. Thiede.

Cutting Steam Hammer Piston

I would suggest that A. J. C. babbit the pistons of his steam hammer to cure the cutting.

A dovetail groove about 2-in. wide, midlength of the piston and 1/32-in. wider at the bottom than at the top of the groove, which should be 5/8-in. deep, letting the metal be 1/64-in. larger than the piston.

M. T. T.

Cylinder Wear

With regard to A. J. C.'s steam hammer trouble, p. 55, November issue, it would seem that his steam cylinder is not made of suitable metal, if all else is correct; that is, it may be too soft to stand the wear. Perhaps the snap rings are too tight, or do not fit the curvature of the cylinder wall sufficiently well. They may not be so proportioned as to have the required flexibility, and instead of them receiving the most wear, as they should, the cylinder suffers instead.

Even assuming the material in the cylinder to be soft, there should be no cutting going on, if the piston and snap rings are properly made, the sharp edges nicely rounded off, and the whole properly lubricated. To make a correct job, the snap rings should be trued up, as we say, in a lathe, after they have been cut. Thus will a good fit be secured and at the same time sufficient spring to make a steam-tight joint. The sharp, square, corners of both rings and piston should be rounded off, and the whole surface well coated with cylinder oil to which a liberal quantity of graphite has been added. Graphite and oil is the proper thing for cylinder lubrication and I think if A. J. C. will substitute it for the oil alone, he will get satisfying results.

Charles J. Mason.

Engine Pounding—Shaft Too Low

In the September number, A. R. M. speaks of a pound in his engine that reminds me of one that I had in an old engine a few years ago, a 16 by 48-in. running 55 r. p. m. This engine had no pound until the cylinder was rebored and new piston and packing rings fitted to it. We started up and everything ran smoothly until it began to cut off, when there was a terrible pound on the head end. The machinist that did the job stayed there for a day and a half trying to get rid of that pound.

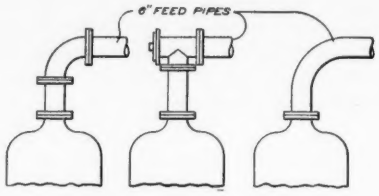
After he left I screwed the piston in the crosshead 1 turn, but that only transferred the pound to the crank end. I then screwed it back one-half turn and the pound returned to the head end again. I then reduced the steam pressure 5 lb., which stopped it except on light loads, when it would continue to pound as long as the load was light. My next move was to take out the piston and rod and line it up, when I found the shaft to be 1/4 in. low. This was raised up, the connections put on and carefully adjusted and when we started up the pound had disappeared.

The diagrams taken from A. R. M.'s engine are fair and if the engine ran quiet would be considered good enough. The compression on the light load is not as high as on the heavy, and this may be the cause of the pound, though I should say that the compression was none too high for 100 r. p. m. The so-called light load looks to me to be more like the rated load of the engine. I would advise giving the steam valves just a little more lead, as it would improve the admission lines on the diagram and I think it would stop the pound.

W. C. Tracy.

Piping Method

Which of the 3 methods of piping shown is the most practical, also what is the per cent loss in each



THREE METHODS OF PIPE TURN

case by condensation of steam passing the elbow, tee and curve?

G. M. C.

"RIGHTLY USED, THE FORESTS will go on producing crop after crop indefinitely. The countries of Europe know this, and Japan knows it; and their forests are becoming with time not less, but more, productive. We probably still possess sufficient forest land to grow wood enough at home to supply our own needs. If we are not blind, or willfully wasteful, we may yet preserve our forest independence and, with it, the fourth of our great industries."

A SMALL BUT STURDY CORLISS

While the Corliss engine has proved its right to be used in large powers, there has been a feeling that for those whose power requirements were modest the smaller cost of the single valve type made that the logical engine for them. The Murray Iron Works Co., of Burlington, Ia., feeling that there are many who need only a moderate amount of power, but would nevertheless appreciate Corliss economy, have designed a small size, one of which was exhibited at the Denver convention.

While small, when compared with the leviathans which the company builds for big central station work, it is just as substantial, just as carefully designed and built as the bigger engines, and is capable of carrying its load just as effectively.

In this connection the findings of Messrs. Dean and Wood of Boston in a report on a series of tests to compare different types of engines, which report was presented before the American Society of Mechanical Engineers last spring, are of interest. They concluded that high class engines for high-speed having 4 Corliss or gridiron valves are advisable for continued good economy and that for a long time guarantee of steam consumption the slower speed Corliss valve engines improve in economy for some time and then maintain the economy for many years. This is ascribed to the nature of the valve as it wears tight to the seat, and not to the speed.

The Murray-Corliss engines in the small sizes are 8 by 18, 9 by 18, 10 by 18 and 11 by 18 in., are arranged as single or twin engines and when used condensing or for special work are fitted with tail rods for driving water pumps, ammonia or air compressors or vacuum pumps.

As in the large Murray engines the cylinder is provided with vertical ports, large steam chests with the corners rounded, ports passing clear through the exhaust valves, a large space for exhaust steam, separated from the cylinder, and a cylinder base made up separate from the cylinder.

Figure 1 shows the engine assembled. It is provided with piping for an indicator, cylinder lubricator and auxiliary hand force pump, oil cups on all bearings, and a Hartner governor.

The frame shown in Fig. 2 is joined to the main bearing and has a foot to support the guides cast with it. It is held by 2 foundation bolts in the bearing and one in the center foot and has a spot on the upper side to carry the governor stand. The guides are bored to fit the crosshead shoes and the frame joins the cylinder casting by a bored and faced joint.

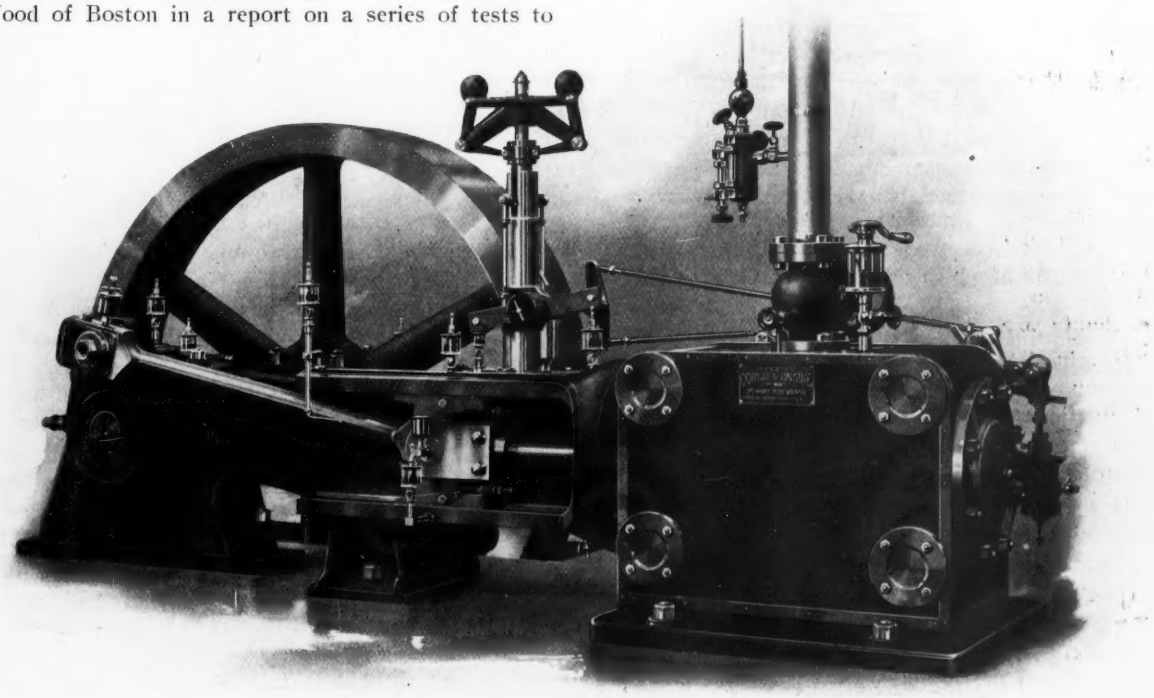


FIG. 1. THE SMALL MURRAY-CORLISS ENGINE; CYLINDER 9 BY 18 IN.

To fasten the crosshead, which is shown in Fig. 3, to the piston rod, the neck is split vertically through the tapped hole for the rod, and has 2 clamping bolts to pinch the rod fast. The crosshead pin has a ground taper fit, and is held by a jam nut. The shoes are babbited, adjustable by stud bolts set into the crosshead and held in place by clamping nuts. Top and bottom shoes are adjustable, have a long bearing on both guide and crosshead and are central over the crosshead pin.

In the Hartner governor, the springs extend from ball to ball, hence, act directly in the line of the centrifugal force, so that these opposing forces balance directly without causing friction on any of the bearings. The pins, therefore, carry little but the dead weight of the governor parts. In addition the pins have ball bearings, all of which renders the governor very sensitive.

Slight variation of speed is secured by means of a weight sliding on a bar at the side of the governor column. A dashpot is provided to dampen sudden fluctuations. The governor is driven by means of a moderate speed belt and miter gears, the same as in large engines.

Foundations for these engines are recommended to be made of concrete, the main dimensions for a 9 by 18-in. being as shown on Fig. 5. For first-class material and workmanship, including American Portland cement, all set surfaces cleaned, picked, brushed and wet and plastered with 1 to 3 cement mortar to make a good joint, on dry hard ground and with normal conditions of speed and power, concrete for the outer foot of foundation should be 1 part cement, 2 parts sand, and 4 parts stone and the inner parts or body 1 cement, 3 sand and 6 stone. The safe load will then be about 27 tons per square foot after 1 month setting. In these proportions, the volumes to use of cement, sand and stone are a mix of 1-2-4, 1 bbl. cement, 7.6 cu. ft. sand, 15.2 cu. ft. stone; for mix 1-3-6, 1 bbl. cement, 11.4 cu. ft. sand, 22.8 cu. ft. stone.

With these proportions and water to make dry concrete, rammed until the water shows on the upper surface, concrete will be made for each barrel of cement as follows: For stone screened to uniform size with 1-2-4 mix 16.3 cu. ft.; with 1-3-6 mix 23.2 cu. ft. For average stone with dust screened out, for mix 1-2-4, 17.2 cu. ft.; with 1-3-6 mix, 24.4 cu. ft. For mixed stone and gravel with 1-2-4 mix 18 cu. ft.; with 1-3-6 mix 25.6 cu. ft. Care should be taken to see that all forms, bolts and castings are set exactly in place as shown by the drawings. Also close inspection should be made of the concrete, as with work done by contract the amount of cement used is likely to be reduced and the concrete made too wet, while with day labor the cement used is likely to be too large, the concrete too dry and too much time spent in ramming.

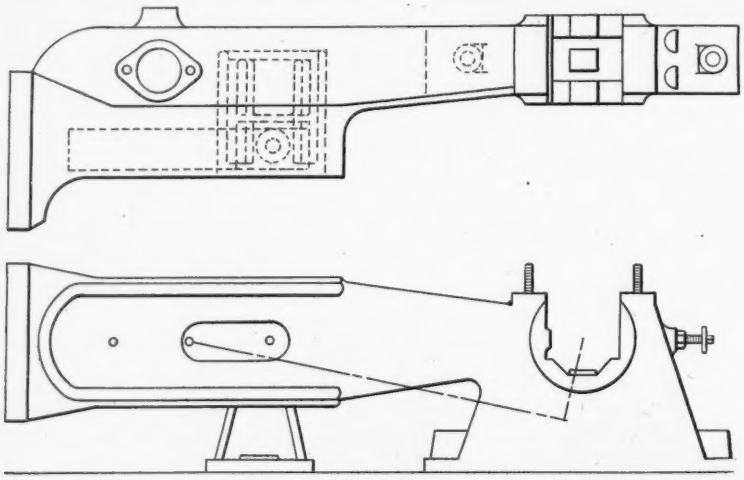


FIG. 2. FRAME, GUIDE, CENTER FOOT AND BEARING IN A SINGLE CASTING

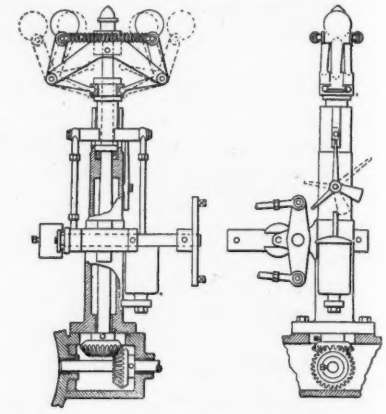


FIG. 4. THE HARTNER GOVERNOR

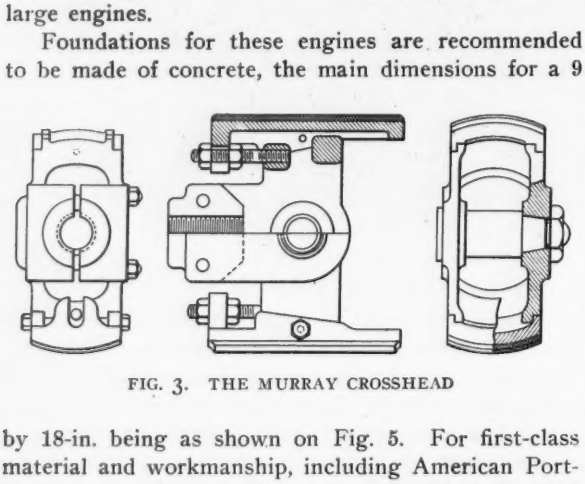


FIG. 3. THE MURRAY CROSSHEAD

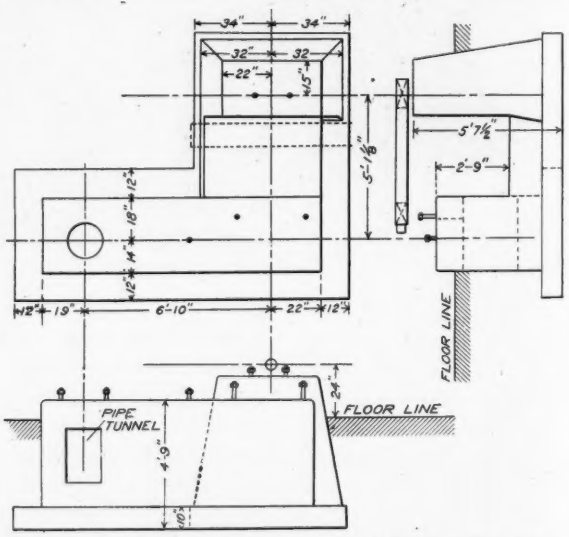


FIG. 5. FOUNDATION PLANS FOR CONCRETE WORK FOR 9 BY 18-IN. ENGINE

POINTS IN AMMONIA COMPRESSOR DESIGN AND OPERATION

By F. E. Matthews

What clearance should be given an ammonia compressor of 5-in. stroke and 3-in. bore running 220 r. p. m.? The compressor was made by the Alamo Iron Works of San Antonio, Texas.

Clearance Allowed

We are not familiar with the details of mechanical construction of the ammonia compressors manufactured by the above named company, and since that company discontinued the manufacture of these compressors some time since, we are unable to get information regarding any pecularities of construction their machines may have.

CYLINDER DIAMETERS AND LIFT OF VALVES FOR AMMONIA COMPRESSORS

CYLINDER DIAM. IN INCHES	SUCTION VALVE		DISCHARGE VALVE	
	DIAM. IN INCHES	LIFT, INCHES	DIAM. IN INCHES	LIFT, INCHES
2 3/4	1 1/16	1/8	1 1/8	3/64
4 1/2	1 3/4	7/64	1 5/32	5/64
5	2 3/16	9/64	2 5/16	5/32
5 5/8	3 1/2	7/32	2 9/16	9/64
6 3/4	4 3/4	3/16	4 1/2	9/64

As a general proposition, however, the pistons of a single-acting vertical ammonia compressor of the above dimensions, assuming that your compressor is of this type, may be set so close to the cylinder heads as to pinch a single thickness of ordinary writing paper as the crank passes center. It should be borne in mind, however, that this is to be the actual running clearance and, if lead or rubber gaskets are employed between the cylinder heads and the cylinders, a sufficient extra clearance must be allowed to make up for any thinning out of such gaskets as the cylinder head bolts are tightened from time to time, when the machine is first put into commission after the insertion of a new gasket.

If the compressor is of the double-acting type, from 3 to 5 times the clearance above suggested for a single-acting machine should be allowed. If the clearance of either a single or a double-acting compressor, having a piston rod running through a stuffing box instead of being of the enclosed crank case, trunk piston type, be adjusted while the piston rod is cold, it must be borne in mind that the rod will lengthen slightly because of the heat generated by the friction of the stuffing box; so that it is safe to set the piston of a compressor of the sizes mentioned above off 2 or 3 thicknesses of writing paper in case of a single-acting compressor and in case of a double-acting compressor the piston may be set off 1 thickness from the crank head and 3 or 4 thicknesses of paper from the head end. When the machine is in operation, the clearance will then very nearly equalize.

As a matter of fact the piston of a small double-acting machine might be set so as to touch the crank-head when cold, were it not for the fact that further contraction in case the system should "freeze back," might cause the piston to strike the crank-head too hard.

Before deciding just what per cent of the total clearance (the sum of the clearances at each end) should be left at either end, the effect of keying up the crankpin and crosshead pin boxes should be studied. Usually keying up shortens the connecting rod, and, in the case of double-acting compressors the amount of clearance allowance to take care of this effect will practically offset the amount allowed for expansion in the other direction.

Lift of Valve

What lift should be given to the top valve?

For want of definite knowledge, we assume that the top valve of your machine is the discharge valve, and that the other valve is either located in the piston, or possibly the piston itself may act as a valve by covering and uncovering ports cut in the side of the cylinder through which the gas returning from the freezing tank enters the cylinder above the piston just as the crank is passing center at the crank end of the stroke.

Theoretically, at least, both suction and discharge valves should have a lift that will give sufficient opening so that the gas velocity through the ports will not exceed from once and a half to twice that in the suction and discharge lines. In designing new compressors, the suction valves should have a liberal lift and be made as large as the cylinder diameter will permit; this because the incoming low-pressure gas is so rare that the slightest resistance offered to its passage causes an appreciable drop in pressure, and a suction within the cylinder lower than that in the suction line from the cooler decreases the capacity of the machine in direct proportion to the ratio of the 2 absolute pressures.

The discharge valves may be given less lift than the suction valves and may be smaller in inverse proportion to the absolute suction and discharge pressures, because the increased pressure produces a proportionate reduction in volume so that proportionately smaller valves will suffice to pass the same amount (by weight) of gas.

Where the compressors are already designed, the amount of lift that can be given the valves will depend largely upon the design, and a safe rule would be to give them as much lift as possible without undue pounding. In large compressors, a certain amount of cushioning effect is employed to prevent undue pounding, but any device tending to retard the closing of valves gives opportunity for a proportionate amount of gas leakage back by the valve while it is closing and occasions a proportionate loss of displacement capacity of the compressor. Such means need not be resorted to in well designed small compressors.

Probably the best idea of what the lift should be in small compressors can be gained from figures representing conservative practice. In a line of compressors developed by the writer some time since, the above dimensions were employed. These dimensions, it may be mentioned, are somewhat more liberal than average practice and were undoubtedly an important factor in obtaining the high efficiencies realized in these compressors.

Cooling the Liquid Ammonia

Would any efficiency be gained by pumping the brine over the liquid line running to the expansion valve, thereby cooling it?

It is axiomatic that one cannot lift himself by his boot straps. All the cold available in the brine comes originally from the ammonia. It is true that the higher the temperature of the liquid ammonia flowing to the expansion valve the less refrigeration it will produce per pound. This is because the first work of cooling performed by the liquid is to cool itself down to the temperature of the cooler, from which it also follows that the lower the temperature of the cooler the less useful refrigeration will be produced per pound of liquid ammonia.

In every transfer of heat from one machine to another there are certain unavoidable losses; first, because a difference in temperature is necessary to cause a heat transfer and it costs energy to maintain a difference in temperature; second, because to effect a heat transfer, certain apparatus in the way of suitable containing vessels has to be provided, and from all of these there is a loss by radiation of cold, or more accurately speaking, by absorption of heat.

If the anhydrous ammonia on its way to the expansion valve cannot be cooled by cold water, which after all is our cheapest cooling means and the one on which the operation of refrigerating machines depends, the next cheapest method is to allow it to cool itself at the expansion valve where there will be no losses due to heat transfers or radiation.

A similar policy to that involved in cooling the anhydrous ammonia on its way to the expansion valve would be the cooling of the condenser water by running it over the frosted suction line to the compressor.

Cooling the condenser water, if effected by natural methods as by a cooling tower, tends to increase the economy of the plant. But here again it is better to employ the cooling effect of the return gas in the cylinders of the compressor where the cooling effect is most needed and where there is little opportunity of loss by radiation and none by heat transfer, than to employ it to cool the condenser water, and then later employ the condenser water to cool the gas after compression.

TO FIND THE DIAMETER of steel shaft required to transmit a given horsepower: Multiply the horsepower by 55 and divide by the revolutions a minute. The cube root of this quotient is the diameter of the shaft in inches.

A NEW SIDE-CRANK HIGH-SPEED ENGINE

FOR some purposes, well informed engineers recognize that the side-crank type of construction is most satisfactory, and in order to be in a position to furnish either this type or the center-crank the Ridgeway Dynamo & Engine Co., of Ridgeway, Pa., has recently perfected the Ridgeway Side-Crank Engine. This is designed for simplicity, strength and quality rather than cheapness, although it is a cheap engine in the long run.

Besides being made of the best material and carefully inspected at all points to see that its parts are interchangeable and standard to gage, it is given a real and severe test of 24 hr. duration under full and overload conditions before leaving the factory. This is done by means of a direct-connected dynamo and a water rheostat which allows the load to be held constant at any point that may be desired. Careful records are kept of load, speed, steam pressure and general performance, and a set of indicator cards is taken after the valve is carefully adjusted.

Bed

Of heavy design and with metal so distributed as to bring the heaviest sections in line with the greatest strains. The main part of the bed is of box section with bored guides of large diameter, these guides and the end of the cylinder being bored and turned at one setting, thus insuring perfect alignment with the cylinder. To make certain, however, this alignment is always carefully tested on the erecting floor by calipering to a steel wire which is accurately centered.

To prevent oil from being thrown against the end of the cylinder, a removable partition with sectional packing around the piston rod is put next to the cylinder end of the bed and a well is provided between the cylinder and the partition to catch the drip from the stuffingbox. Openings are provided for packing the piston rod stuffingbox and for inspecting crosshead and pin. Over the crank disk is a light sheet metal oil guard, arranged so that it can be turned back over the bed, giving access to the connecting rod and crankpin.

The main bearing is of the quarter box type, having shells lined with babbit metal carefully pened in place and bored out in accurate jigs. Horizontal adjustment is secured by a wedge, and vertical adjustment by drawing down the cap. The top and bottom shells are interchangeable and may be removed without taking off the shaft.

Connecting Rod and Crosshead

In the connecting rod, which is forged from the best open hearth steel, a minimum factor of safety of 15 is used, thus giving ample strength. Both ends are slotted out of the solid forging, the wristpin box being of solid phosphor bronze and the crankpin box lined with genuine babbit. Both ends are adjusted by wedge and bolts. Cast steel is used for the crosshead body with shoes of cast iron faced with babbit metal

and turned to fit the bored guide. The upper shoe is bolted solid to the body and the lower shoe is easily adjustable, but means are provided for adjusting both top and bottom shoes by the use of shims should this be desired. The wristpin is of high carbon steel tapered to fit seats in each side of the crosshead body and provided with keys so that it may be turned to 90 deg. as it wears.

The Cylinder

This is of cast iron, the walls being thick enough to stand several reborings when necessary, and the barrel being covered by a heavy polished cast iron lagging, with a polished false head over the cylinder head and nuts. The valves are of flat balanced type, having heavy pressure plates which relieve them of thread with a jam nut to prevent turning, and the jam nut held by a set screw in the crosshead body.

The main shaft is a single forging, extra large in the bearings and increased in the governor wheel hub. The crank disk is of semisteel with a large sized crankpin cast solid with the disk. The shape of the disk is such that satisfactory counter-balance is obtained. After the pin is cast and the shaft bored, the crank disk is forced into place on the shaft by hydraulic pressure and secured by a heavy key.

Governor

The Ridgeway governor, formerly known as the Begtrup, was the pioneer inertia governor. A long bar, called the inertia bar, having weights at each end, is pivoted at the center on a roller bearing. The

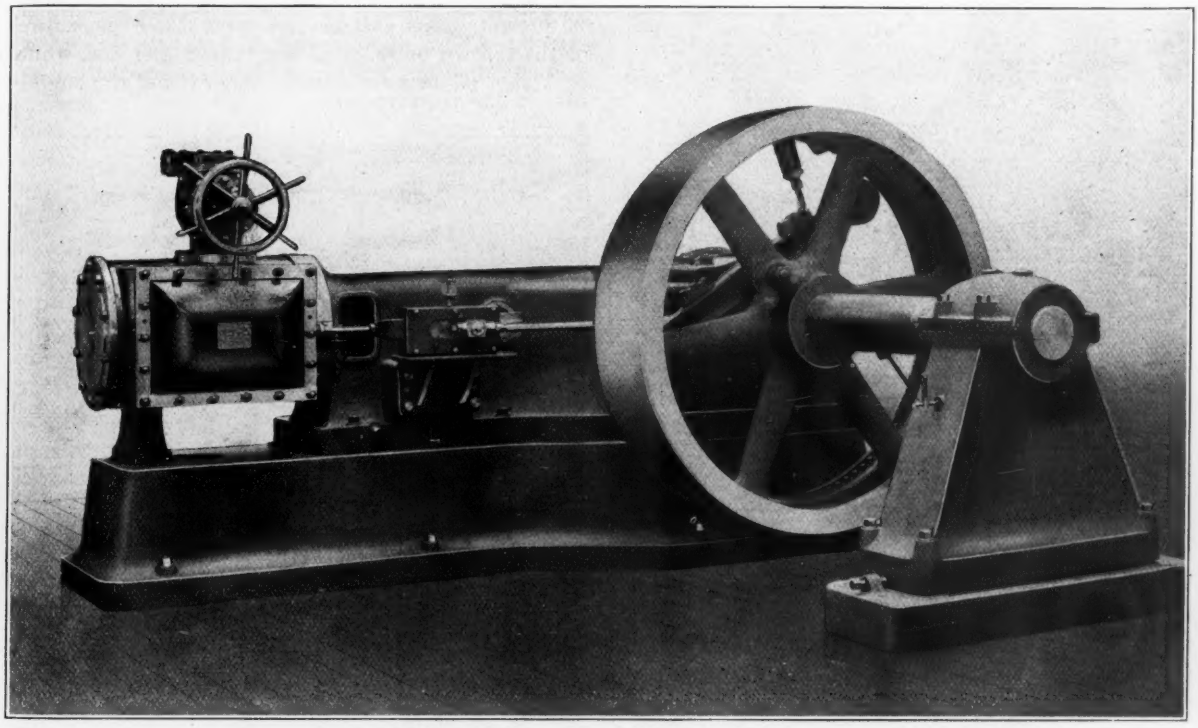


FIG. I. VALVE GEAR SIDE OF RIDGEWAY SIDE CRANK ENGINE

all pressure. In the pressure plate are cored ports corresponding with those in the valve seats and connecting through side openings with the main ports, thus making a double-ported valve, and giving an indicator card with a steam line holding up well and a sharp cutoff. In case of water being carried into the cylinder both valve and pressure plate lift from the seat, allowing the water to pass into the exhaust so that relief valves are not needed.

The piston is a single hollow casting braced by ribs and made as light as strength permits. Cast-iron snap rings of special design are used, which prevent leakage and avoid appreciable wear. The rod is forced into the piston on a taper supplemented by a jam nut, and screws into the crosshead with a long fine

main pin is made large and heavy and is of steel, hardened and ground. The inertia bar is lined with hardened steel bushings and the space between pin and bushings is filled with hardened steel rollers, which insures a minimum of friction, so that the bearing is subject to very little wear. This is the only bearing requiring lubrication, although it will go without attention for several weeks.

To the hub of this bearing is clamped the eccentric, which is keyed in place, and is also held by set screws. The eccentric and eccentric strap, being split, are removable without disturbing the governor or the setting of the valve.

A heavy coil spring is secured to the middle of one end of the bar. Opposite the spring is an oil dash

pot, consisting of a cylinder with a loose fitting piston and a connecting rod bolted to the inertia bar. A bypass with an adjustable opening allows the oil to circulate from one side of the piston to the other. The governor is perfectly reversible without the use of any extra parts.

Referring to Fig. 1, the action of the governor is as follows: Rotation being from left to right on top, the weight in the spring end of the bar being the greater, centrifugal force tends to swing it outward and backward toward the upper stop. This tendency to move backward is balanced by the spring, whose tension is such as to hold the inertia bar in equilibrium when the engine is at its desired speed. When starting up, the position of the governor parts is as

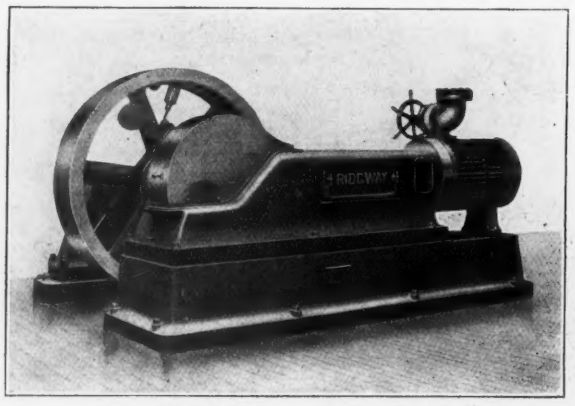


FIG. 2. CRANK SIDE OF RIDGEWAY ENGINE

shown. In this position the eccentric travels in its greatest path, giving the valve its widest opening and latest cutoff.

As the speed increases, centrifugal force, acting on the weighted end of the inertia bar, moves it backward towards the upper stop, thereby reducing the travel of the valve and cutting off steam earlier. This backward movement of the bar is continued until the travel of the valve reduces cutoff to just the amount necessary to keep the engine rotating at its proper speed to give even balance between centrifugal force acting on the inertia bar and the opposing tension of the spring.

Now, suppose that a load is applied to the engine. There is a check to the speed of the governor wheel, while the inertia bar, by reason of its momentum, rotates forward sufficiently to increase valve travel and give late enough cutoff to carry the load. Should the load be thrown off, the governor wheel tends to increase its speed, thus causing the inertia bar to swing backward and reduce valve travel and cutoff until equilibrium is established as before.

From this it will be seen that the speed of rotation, under a steady load, depends entirely upon the equilibrium between centrifugal force acting on the inertia bar, and the tension of the governor spring, while the actual movement of the governor parts is effected by the inertia of the weighted end of the bar.

If the weight in the inertia bar and the tension of the spring are so adjusted that the centrifugal force increases faster than the tension of the spring, then the engine will speed up under load. In this condition the engine is liable to race, and it is to prevent racing that the dash pot is used. It is thus possible to adjust the engine so that it will run faster under load than when running light, and still have it regulate perfectly with no tendency to race. Contrariwise, the governor may be adjusted to run slower under load than with no load. Dash pots are used on all engines, as by their use perfect stability is obtained and at the same time they increase the ease with which adjustments may be made.

No difficulty is experienced in adjusting this engine to govern within a limit of one revolution, and the instantaneous variation of speed when the entire load is thrown on or off is less than 2 percent, while the action of the governor is so quick that the engine

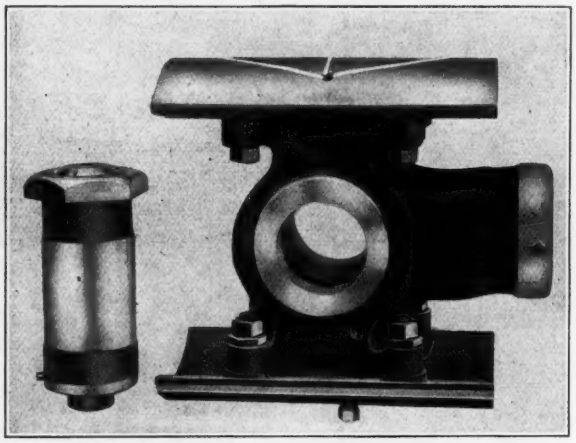


FIG. 3. RIDGEWAY CROSS HEAD AND PIN

returns to its normal speed with a single vibration and within a space of 2 seconds.

Lubrication

Two standard methods of lubricating this engine are provided. In the first, known as the "splash system," the crank pit is filled with oil, which the disk throws in an almost steady stream over the crosshead and guides. Oil from the upper guide is wiped off by the top crosshead shoe and flows through passages and pipes to the crosshead pin. Pockets on the inside of the crank guard collect great quantities of oil which are led through ample passages to the main bearings and to the crank pin. All bearings are, therefore, practically flooded at all times. This system will be furnished, unless otherwise specified.

The second standard system, furnished at a slight extra cost, uses a small but very efficient filter placed in one side of a tank, which is mounted on the subbase below the slide bracket. In the other side of the tank is a valveless pump driven by a cam on the valve

gear ram, which cam is so designed as to give a full stroke regardless of the travel of the ram. All oil from the bearings flows to the crank pit, from which it is piped to the filter, then passes to the pump chamber where it is pumped to a large tank on top of the bed. From this tank the oil flows through nickeled piping to each bearing. Sight feed valves are placed in each pipe near the tank so that the supply may be shut off or regulated. As the engine is fully enclosed, no oil can be thrown onto the floor or into the governor wheel. With either system the valve gear is supplied with grease cups, which are both effective and cleanly.

Types

This engine is built in the simple tantem and cross-compound types. In the compound types the low-pressure valve is of the balanced type, though slightly modified from the one previously described. On tandem engines both valves are driven by the governor, the low-pressure directly and the high-pressure by means of a tail rod on the low-pressure valve. On cross-compound engines the high-pressure valve is driven by the governor and the low-pressure by a fixed eccentric on the main shaft; otherwise the valve gear is identical for each cylinder.

The valve gear is simple and strong, with ram slide having a long bearing provided with vertical and horizontal adjustment. The eccentric strap is lined with babbit, pened, bored and scraped, while the bearing and slide is lined with replaceable bronze bushing.

Outboard Bearing

Broad at the base to insure stiffness and built on liberal lines, the outboard bearing is in perfect harmony with the bed and sub-base. This bearing is of the self-oiling, self-aligning type, with shells lined with babbit metal, vertical adjustment being accomplished by special devices such as used on the crosshead, and horizontal adjustment by means of ordinary set screws and lugs. By means of 2 reference points on the side of the crank disk and one on the solid plate, the shaft may be tested at any time for alignment, and adjusted by shifting the outboard bearing, as may be found necessary.

"TAKE STOCK OF YOURSELF frequently and find out whether you are developing and getting ahead, and if you are not, find out the reason and do not blame anyone but yourself, for development and improvement depend upon yourself alone."

RAPID CONSTRUCTION in large buildings has made large advances in recent years. Now comes a contractor who has built a 5-room cottage at East St. Louis in a single day from the uncleared lot to the complete house, painted, plastered, gas and electric light and modern bath room complete, at a cost of $2,000. In another year or so we shall be able to order 3 or 4 assorted dwellings sent out from the department stores on trial to see how they fit the lot and the surroundings.

USE OF PACKINGS

Fibrous packings, such as asbestos, cotton duck and rubber, flax yarn packings, pure rubber and metallic packings are extensively used in all countries for various purposes, such as air compressors, ammonia compressors, air brake pumps, acid pumps, high and low-pressure steam engines, gas engines, hot and cold water pumps, and all machines having valves and pistons where steam, air or gas is used, which require packing.

Some classes of packings are better adapted for particular services than others, and the question of

ASBESTO-METALLIC SHEET AND RUBBER CORED SPIRAL PACKINGS

the proper kind of packing to use for a certain purpose is one that should be left entirely to the manufacturer of the packing.

How and When to Use Packings

The question of when to put in packing is determined entirely by the condition of the old packing in the machine. We know that all new machines must be packed before they can be used. When the packing has been in service a certain length of time and shows deterioration it should be removed from the stuffing box. Clean the box thoroughly and swab with oil before putting in new packing.

The question of how to use the packing is very important, for if the packing is not used properly, no matter what class of packing is used, it will not give the service to the user that it should. A given class of packing will not work on some engines the same as on other engines and, therefore, must be handled differently. This is caused by the expansion and contraction, also whether it is used for steam, air, gas or ammonia, as these different elements make considerable difference in the way the packing acts. What one engineer will use successfully is sometimes useless to another engineer. Care and judgment must always be used to get the best results, and the engineer should study the proposition of the packing very carefully.

When first applying the packing always see that it is a proper fit, joints broken and firmly seated in the stuffing box by adjusting the gland, and after the packing is seated the gland should be slacked off to allow the packing to expand as far as it will. Screwing up on the gland tightly and not allowing expansion takes the life all out of the packing and is apt to score the rod, burn the packing and cause a blowout.

so that the steam, gas or other contents of the line will seep their way through and a consequent leak and a blowout will occur.

Also, the flanges should have a smooth surface and when old flanges are first packed they should be cleaned thoroughly and smoothed up. It is a good idea to immerse the gasket in oil and graphite so it will not stick to the flanges when removing. Care

HYDRAULIC RING. JOINTLESS ASBESTO-METALLIC GASKET, AND RUBBER CORE EXPANSION PACKINGS

Method of Measuring and Cutting Packing

In regard to the method of measuring packing; for ring packing the outside diameter of the rod should be carefully taken, the inside diameter of the stuffing box and the depth of the box should also be measured carefully. This applies particularly when ordering ring packing. These measurements should be exact to get the best results.

In cutting spiral or coil packing, it is best to wind the spiral or coil around the rod tightly and then cut rings on the rod. First, always see that the packing is the proper size to go into the packing space without crowding or hammering it in. It should be a neat fit, not too loose nor too tight. In cutting the material a sharp knife should always be used to cut the packing sharp and clean. The joints of the rings should be broken when packing in this manner, the same as in using packing which is furnished by the manufacturer.

Tools for Packing Piston and Valve Rods

There are a number of packing tools on the market for packing piston and valve rods, also tools for removing the packing from the stuffing boxes.

To insert the packing, a straight steel bar about 12 in. long, round at one end and flat at the other, is a good tool. The rings will, however, crowd one another into place so that the gland when taken up seats the packing.

For removing the old packing, a wire packing screw similar to a corkscrew is probably about the best implement. Small steel hooks are also used extensively.

Packing Flange Joints and Cutting Gaskets

Too much care cannot be exercised by the engineer or whoever cuts the gaskets from sheet packing for flange joints, cylinder heads or boiler manholes. If the packing is not cut properly to size and does not lie on the flange evenly, it will not work satisfactorily. Being cut too large will cause wrinkles in the packing should also be used to see that any flange joints that are to be packed are in line, or, in other words, the 2 surfaces come evenly together or flush on all sides. If they do not, the result is that the packing is taken up on one side more than the other, reducing the thickness and leaving the other side a little open, liable to a leak or blowout.

The best gasket to use is one that is manufactured by the maker to the size required. If measurements are sent in correctly you are sure to get the proper fit. Care should be used in sending measurements for gaskets. Where the line is uneven and the joints do not come together flush, an extra thickness or one-half a gasket can be used for the open side, thereby filling up the space, which the original thickness would not do if used entirely around the flange.

Special care should be used to see that the proper material for gaskets is furnished for each particular purpose.

LARGE INDUSTRIAL ORDERS FOR POWER MACHINERY

As continued evidence of awakening industrial activity in various parts of the country, mention of some of the orders taken by Allis-Chalmers Co., since the long list recently reported, is of exceptional interest at this time.

In the state of Wisconsin, where authorities estimate there are at least 2,000,000 hp. in unused water powers, large developments have recently been under taken, and among the important hydraulic turbine plants of this section contracted for is that of the Northern Hydro-Electric Co. on the Peshtigo river. The initial installation will consist of 5 horizontal twin-turbines, each having a capacity of 1,500 hp., or an aggregate of 7,500 hp., each direct connected to a 1,000-kw. alternating-current generator, with exciter units of 400 kw. combined capacity, all the machinery being of Allis-Chalmers Co.'s build.

This plant, which is near that of the Wausau Street Railway Co, now being equipped with hydroelectric units, will be second in industrial importance for the Head-of-the-Lakes country only to the Great Northern Power Co's. immense development, where 40,000 hp. in Allis-Chalmers turbines—the largest single Francis wheels in the world—are in operation. The current generated on the Peshtigo river will be transmitted to Green Bay and neighboring towns, to be used for the operation of the street railway system, commercial lighting and manufacturing purposes.

Other large orders placed with Allis-Chalmers Co. for hydroelectric plants include irrigation projects and central stations for power distribution in the middle west, the plans of which have not yet been made public.

Four noteworthy machines now being shipped from the works at West Allis are 2 6,500-kw. generators of the waterwheel type for the Niagara Falls Hydraulic Power & Manufacturing Co., Niagara Falls, N. Y., and 2 of 2,500 kw. for the Cazadero station of the Portland, Oregon, Railway, Light & Power Co. These machines which are designed for 25 and 33 cycles and speeds of 300 and 333 r. p. m., respectively, have recently shown some notable results on shop tests.

Among purchases of the steam turbines built by Allis-Chalmers Co. are a 3,250 kw., machine for the Pacific Mills, of Lawrence, Mass., which already has 3 of these turbines and generators in service, as shown in the leading article in this issue; units of 1,000 kw. capacity for the Cleveland, Southwestern & Columbus Railway and the City of Nashville, Tenn., and 500-kw. machines for the Webster & Southbridge Gas & Electric Co., of Danville, Va., Pennsylvania Power Company, City of Dunkirk, N.Y., Willamette Valley Co., and City of Frankfort, Ind. In addition to the main units these orders include exciters, power transformers, lighting transformers, condensers, circulating pumps, switchboards, etc., making complete power plant equipments for the generation and distribution of alternating current.

The Industrial Lumber Co., Beaumont, Texas, is preparing to install 2 engine-type generators of 450 kw. capacity, with 17 induction motors; the Johnson Chair Co., of Chicago, has bought a 500-kw. generator driven by a cross-compound engine; the City of Waverly, Ia., recently ordered a belted unit of 225-kw., and the Columbia Shade Cloth Co., New York, one of 300 kw., with a line of 26 direct-current motors; the City of Blue Ridge, Ga., has contracted for a 150-kw. alternator, with transformers, switchboard and motors; the Yampa Smelting Company for a 200-kw. induction motor-generator set and three 100-kw. transformers; the American Sugar Refining Co., for a 500-kw. generator driven by a heavy duty engine; the American Oak Leather Co., of Cincinnati, for a 250-kw. belted unit, and the Heekin Can Co. of the same place for additional equipment, including 21 motors. All of the machinery ordered is to be built in the shops of Allis-Chalmers Co. and comprises auxiliary apparatus similar to that above mentioned.

The Oliver Iron Mining Co., which has over a score of hoisting engines installed in its mines at the head of Lake Superior, is having 3 additional units, 28 by 60-in., built in the West Allis shops at the present time; the Alaska-Treadwell Mining Co. has ordered a sixth engine of the Allis-Chalmers Co's. design; and the Right of Way (Can.) Mining Co., Octave Mining Co. and Goldfield Consolidated Mining Co. are preparing to install similar units, except that the 2 hoists purchased by the first-named company will be driven by motors instead of engines.

In the pumping engine field a large number of negotiations are being brought to a definite conclusion in some cases after months of delay. Among orders recently placed for Allis-Chalmers machinery is the contract for a vertical, triple-expansion self-contained pumping engine, of 12,000,000 gal. daily capacity, to be installed by the City of Milwaukee in its North Point Station, not far from where the first machine of this type ever built has been in continuous service for more than 20 years. In industrial plants, the most noteworthy addition to present equipment is that of the Pittsburg Steel Co., which has ordered a double-acting vertical compound pumping engine for delivery of 15,000,000 gal. daily. The Hackensack Water Co. of New Milford, N. J., has contracted for a vertical triple expansion pumping engine of 14,000,000 gal. daily capacity; the City of Rock Island, Ill. will install a centrifugal fire service pump with capacity equal to a daily delivery of 2,000,000 gal.; the City of Coquet, Minn., a 5-stage unit of 1,000,000 gal. daily; the Delaware, Lackawana & Western Railway purchased a 6-stage centrifugal pump for lifting 7,500,000 gal. daily; and the Metropolitan Water & Sewerage Board of Boston, Mass., has ordered a centrifugal pumping engine with complete appurtenances, for a station of 100,000,000 gal. delivery daily.

SPEAKING OF putting news into descriptions, Walter B. Snow, publicity engineer of Boston, said recently: "In the best journals the so-called "write-up" has been placed upon a relatively high plane. This has been made possible by such absolute independence of the editorial and the advertising departments that articles of merit may be described regardless of the fact that their manufacturers are not advertisers in the particular paper. This condition opens the way for much more legitimate technical publicity than is secured by the average advertiser. If he will but understand the editor's attitude, he will see that the description of his particular product or system is withheld or given solely upon the basis of its novelty or its relation to the field covered by the given journal. If he has something really new it will be described. If he has acquired the art of making news out of the facts that others neglect, he may frequently find his name in print, with at least indirect benefit to his business."

QUESTIONS AND ANSWERS

Our readers are invited to send in their troubles and problems; also to answer questions which are asked. All letters must have name and address of writer, which will not, however, be published. If answers are wanted by mail, send stamp for reply.

Cleaning Polished Brass

What is a good formula for cleaning and polishing my finished brass work? T. C. W.

Brake Band

B. F. M. can widen his brake band from 3 in. to 5 in. if he so desires, for widening the band will distribute the friction over a larger area and the heat thus generated will be more readily diffused. However, if B. F. M. will substitute a camel hair belt for his leather, he will obtain much better results. Camel hair belt is recognized as the standard brake band belt by most leading automobile manufacturers.

B. A. F.

D Valve Design. Oil Fired Boiler Setting

Why are D slide valves so designed that if equal lead be given unequal cutoff will take place?

Will some reader please give a good sketch of a return tubular boiler setting and fire bridge wall where crude oil atomized by steam is used as fuel? Many use the usual fire bridge wall used for coal; would like to know if it could not be improved on. Z. B. R.

Protecting Bright Work

A. C.—In answer to your request for a method to keep valve bonnets bright, I send the following: Cake tallow, 1 lb.; gum camphor, 2 oz.; beeswax, 2.5 oz.; raw linseed oil, 8 oz.; kerosene oil, 10 oz.; tripoli, 5 oz. Melt the first 3 together; then add the last 3 and stir until cold. D. W. Madlem.

Storage Battery Charging

W. E. C.—Please tell me how to make a suitable resistance to charge a storage battery, where the line voltage is 250 volts and the voltage required for the battery is 6 volts.

The battery I wish to charge consists of 3 cells, contained in a rubber case 3 by 7 by 12 in. outside measurement. I should judge the plates to be about 3.5 by 6 in. The capacity of the battery is 6 volts, with a rated output of 50 ampere hours. The charging rate is 4 amperes.

The energy wasted in reducing the voltage to that suitable for charging the battery doesn't make so much difference so long as the device is not too expensive.

A.—In regard to the arrangement for charging your ignition storage battery, it is a pretty stiff jump from 250 to 6 volts. It means that you have to use up on resistance 244 volts, and to carry 4 amperes will take a resistance of 61 ohms. If you use iron wire entirely, you will need a number 16 wire 2075 ft. long. This could most conveniently be wound up on a piece of drain tile and on a 6-in. tile would require about 1,000 turns. One end could be connected permanently to the circuit, the other connection to the iron wire end should be arranged to slide along the wire so as to vary the amount of resistance.

Another resistance which could be used, would consist of 16 220-volt lamps connected in parallel, and put in series with them 205 ft. of No. 16 iron wire arranged with a sliding contact.

A cheaper form of resistance, but one which will not be steady, and will require considerable looking after, would be a couple of iron plates dipping into a water bath having 15/100 of 1 per cent by weight of common salt. The plates should be 11 by 8 in. and set 1 foot apart, arranged so that the distance between them can be varied to give the required current flow. The resistance of this last device can be changed either by changing the distance between plates or by changing the amount of salt in solution. The resistance will vary also with temperature of the water, which will change during the time of charging the battery, so that the device must be watched and frequently adjusted to keep the current at the right amount, and an ammeter should be kept in circuit with the battery so that the amount of current flowing will always be known.

Tempering Brass

Answering G. and F.'s questions, which appear on p. 57, November issue, I would say that rolling sheet brass will make it hard and springy. When the sheets are made at first, the metal is hard and springy and, if it is desired to soften it and so make it pliable, the sheet will be heated and plunged into water, in the same way as a blacksmith tempers steel tools, but with the opposite effect.

By running a softened sheet of brass through the rolls, it will again become hard and springy, according to how much it is rolled, and what pressure the rolls rest upon the sheet. Doing this, however, tends to make the sheet thinner, not enough perhaps to make any difference if only a spring is to be made from the sheet. Hammering is sometimes resorted to, but it is not so even in its effects as rolling.

C. J. M.

A THIN COAT of lampblack and linseed oil will greatly improve the appearance of steam heating pipes.

ALBERGER CENTRIFUGAL CONDENSERS

Within the last few years centrifugal pumps have come into use for nearly all kinds of purposes and in fields where before they were thought to be unavailable. The use of improved forms of runners and the connection of 2 or more pumps in series has solved many problems. In the line of machinery made by the Alberger Condenser Co., of New York, centrifugal pumps are used specially with the large condensing outfits for circulating the cooling water through surface condensers and for removing the condensing water from the chambers of jet condensers, this latter combination being known as a centrifugal condenser.

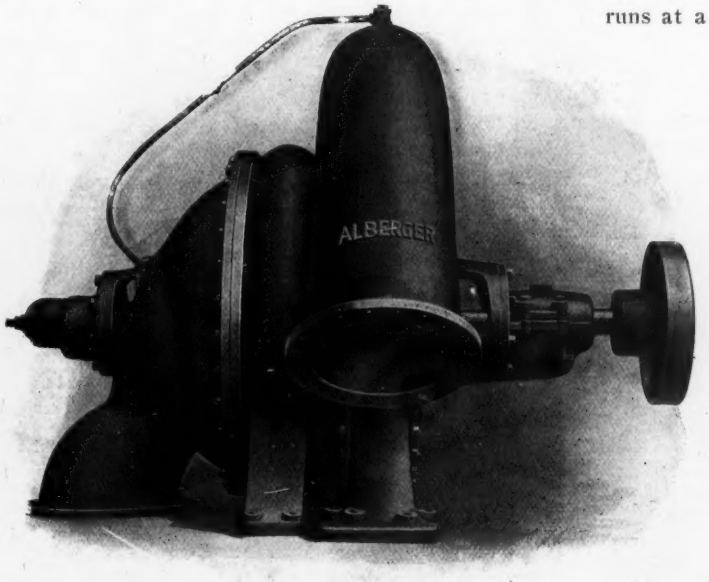


FIG. 1. ALBERGER 2-STAGE VOLUTE PUMP

Figure 1 shows the Volute pump in 2-stage form as used for direct-connection to an engine. In this type 2 runners are arranged within a single casing, one runner drawing the water from the well and discharging it to the second runner, which takes it to the discharge of the pump. This machine is capable of operating against heads of from 60 to 80 ft. with ordinary engine speeds, and is used in circulating the water in a condensing system and also lifting water to the cooling tower. Bearings are carried on brackets extending from each side of the casing. The impeller is double, of the closed type, and made with especial care to get the greatest accuracy and smoothness of vanes.

In the barometric condenser it is necessary to have the draft on the tail pipe equal to the pressure of the atmosphere. This requires the condensing chamber to be elevated 34 ft. and in many situations it is difficult to find room for it and to locate the apparatus properly with respect to the engine exhaust. To overcome these difficulties the Alberger centrifugal condenser has been designed and, as seen in Fig. 2, consists of the chamber of a barometric condenser mounted directly on the base which carries a centrifugal pump. The pump may be driven by an engine, as shown, or by electric motor or belt. The pump runs at a constant speed and delivers to atmosphere the water which it takes from the condenser.

Exhaust steam enters at the large opening on the condenser and air is taken out by a dry vacuum pump from the small opening near the top of the air cooler. Cooling water enters at the injection opening opposite the exhaust. The discharge pipe should have a check valve placed next to the pump, this valve having a free port area when opened, without grids to collect debris.

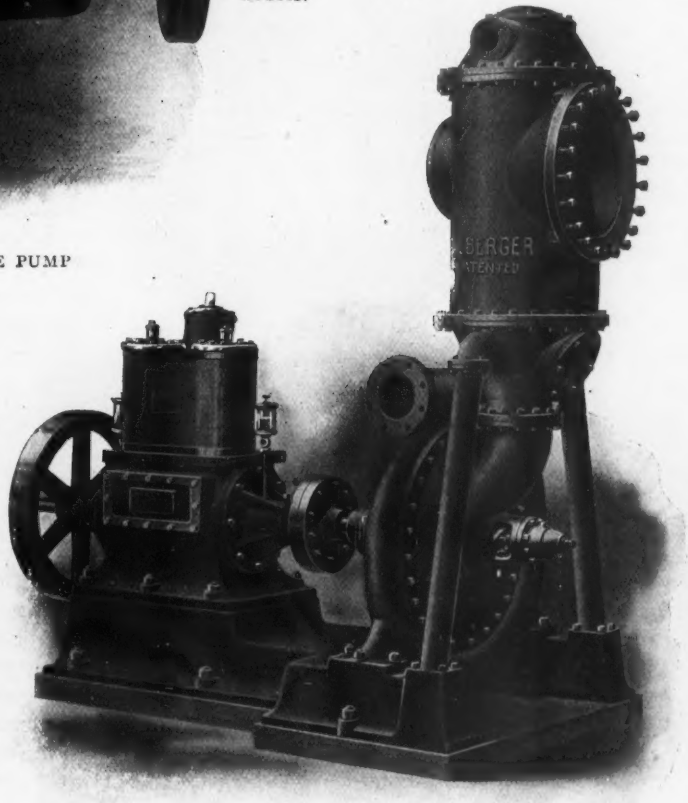


FIG. 2. ENGINE-DRIVEN CENTRIFUGAL CONDENSER

This centrifugal condenser unit can be placed in the basement of the power house with a short exhaust pipe from the engine or steam turbine and provided with a gate valve and an exhaust relief to the atmosphere. With the gate valve in the exhaust pipe closed, the centrifugal and vacuum pumps are started and vacuum produced sufficient to lift the injection water

to the condenser, this lift being not over 20 ft. As soon as the circulating water starts to flow, the gate valve in the main exhaust may be opened and the condenser is ready to take steam. The centrifugal pump may be so arranged as to discharge directly to cooling towers if they are used.

A special application of centrifugal apparatus is the return water turbine which comes in where the

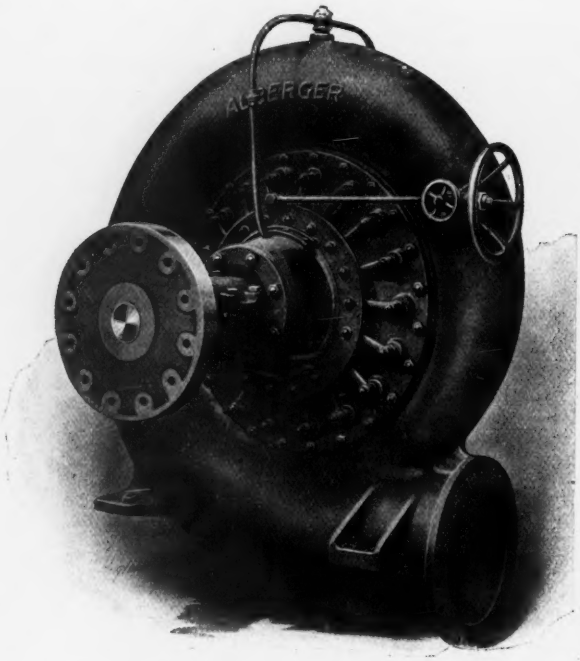


FIG. 3. ALBERGER RETURN WATER TURBINE

condenser is located at a considerable elevation above the circulating water pump. The circulating pump under these conditions would have to work against a considerable unnecessary head and to recover part of the power that would be lost in raising this water, the pumping unit is provided with an Alberger power turbine direct connected to the engine shaft at the end opposite from the circulating water pump.

The turbine takes the return water from the hot well of the barometric condenser, thus furnishing a considerable part of the power needed to drive the circulating pump. The water turbine is provided with a draft tube extending into a tail race, the water level of which fluctuates the same amount as that of the supply well for the circulating water pump, so that a fall of level in the river assists the water turbine at the same time that it increases the load on the pump, and vice versa. This Alberger water turbine is the reverse of the centrifugal pump. Water under head enters the large end of the volute casing and passes inward, being guided by the vanes to give the proper angle of entrance to the impeller or wheel. The water flows out at the center after having given up its energy to the wheel and shaft. This system is specially adapted to power house locations, where the condenser cannot be placed near enough to low water to lift the circulating water by suction in a reliable manner.

THE RIGGIN BLOWOFF VALVE

Long life, seats protected while mud and scale are blowing out of the boiler, extra heavy construction to withstand heavy pressure, a free discharge, a removable seat and disk, and only 2 parts subject to wear, combined with a series of severe tests that have lasted over 2 years without a cent of expense for regrinding of seat or other repairs, are the features which make this new blowoff valve notable.

The Riggin valve has a brass body, at the upper side of which is a stuffingbox with screw gland fitting

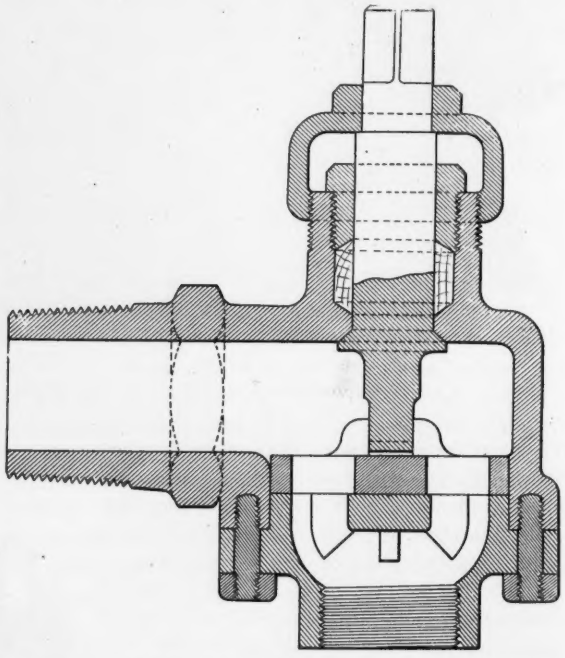


FIG. 1. THE RIGGIN BLOWOFF VALVE FOR LARGE SIZES

into the inside and a lock nut screwing onto the outside of the box to hold the disk to its seat when filling a low-pressure boiler. At the bottom of the body a brass seat screws on, having large discharge area and 2 openings through which discharge takes place. The valve disk has 2 corresponding openings which may be turned either to match the openings of the valve seat or so that they are opposite the solid part of the valve seat. On the upper side of the disk are projections between which a T head on the valve spindle fits so as to turn the disk back and forth. The valve spindle passes through the stuffingbox and has at the upper end a square shank and also a shoulder against which the lock nut fits to hold the disk to its seat. This valve is patented by the manufacturers, the Monarch Machine Works, of Altoona, Pa., who state that the valve will give longer service at less expense than any other blowoff valve on the market, and the proof

of the statement is that one valve was operated 2920 times, working perfectly each time and without a cent of expense for regrinding or repairs. The valves are available in sizes from 1 to 2½ in.

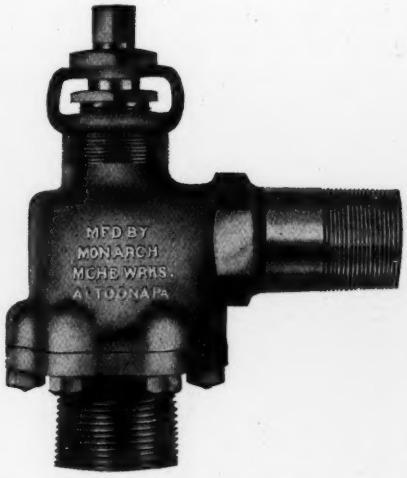


FIG. 2. CROSS SECTION OF RIGGIN VALVE

A REPRESENTATION OF RUBBER MANUFACTURE

During the recent Founder's Week celebration in Philadelphia, one day was devoted to an exposition of the industries of the city by means of a parade in which floats represented the different lines of manufacture. To show the process of rubber making, the Quaker City Rubber Co. prepared 3 floats, showing the steps from the gathering of the crude material to the finished product.

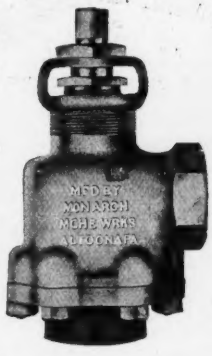


FIG. 3. RIGGIN VALVE FOR SMALL SIZES

The first float showed a rubber plantation with natives in realistic costume. In the midst was a South American hut, surrounded by a growth of rubber trees. The different stages in the process of "tapping" the trees and turning the liquid rubber into a solid mass were fully illustrated. The process is most interesting.

Representatives of the company made a V-shaped incision in the rubber tree, out of which the liquid rubber poured into a bucket suspended directly underneath the outlet. Many incisions are made in

FIG. 1. THE FIRST FLOAT; GATHERING THE RUBBER

the same tree, and under each outlet a bucket is suspended. Having secured the liquid rubber, the next step is to get a calabash, fill it with a certain kind of highly inflammable nuts, light it and over it hold a paddle containing the rubber.

Smoke and heat from this flame quickly congeal the mass, and it is so hardened that it is necessary to split the mass in order that the paddle may be ex-

FIG. 2. THE SECOND FLOAT; MANUFACTURING PROCESSES

tracted. The hardened mass is known as a "biscuit." It shapes itself up, when subjected to the heating, exactly like a watermelon. The people on the float were dressed like South American natives, and made a striking picture as their dusky faces and hands appeared against the background of their snow-white

clothes. Eleven men were on the float, all members of the various departments of the Quaker City Rubber Co.

The second float represented the manufacture of certain articles made by the company. The float contained a work-bench, a "calendar roll" (used for uniting by means of great friction and pressure the duck and rough rubber contained in the fabric used for belting, fire hose, etc.), and 11 men. The calendar was shown in action, and the rubber could be seen coming out of the end of the machine in its finished state.

The third and last float exhibited the many finished

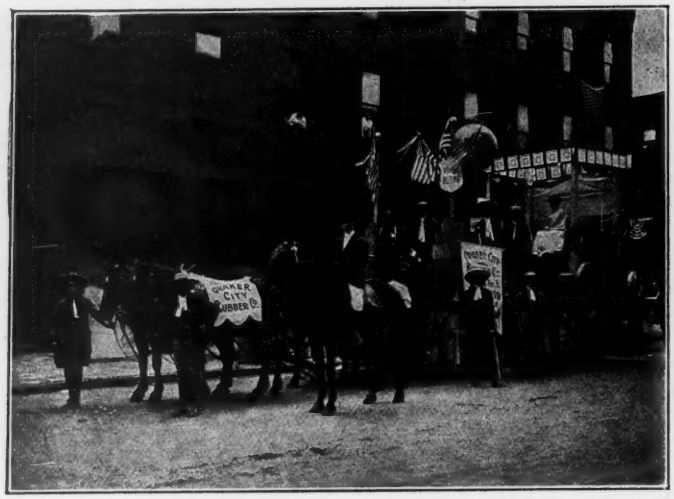


FIG. 3. THE THIRD FLOAT; THE FINISHED PRODUCT

products made and sold by the company. Among other things it contained 2 pyramids of rubber belting, a reproduction, 4 ft. square, of the box used in shipping Daniel's "P. P. P. Rod Packing;" a large roll of Daniel's "Ebonite" sheet packing 5 ft. high and 2 feet in diameter.

On top of the several piles of packing was placed a globe of the world (3 ft. in diameter) containing the words, "We ship to all parts of the world." On the back end of the float was a throne built entirely of "Ebonite" and "Skihi" sheet packing, the roof being made entirely of the boxes used in shipping Daniel's "P. P. P." packing. The young lady who sat on the throne represented Miss Philadelphia. The festooning around the third float was entirely of the several brands of the water, steam, air and fire hose made by the company. The idea of the float was to show that the Quaker City Rubber Co., situated in Philadelphia, ships to all parts of the world.

W. H. Carmint, cashier of the company, worked out the ideas and superintended the construction of the floats, and deserves warm congratulation.

ONE METHOD USED for oiling the piston in an engine using high temperature steam is the turning of grooves in the piston, which grooves are kept filled with oil.

THE AMERICAN INSPECTOR'S OUTFIT

This kit is designed specially for the testing of gages and is put up in portable form for the greatest convenience, to meet all requirements of government power plant and boiler insurance inspectors.

The otufit includes a 3-in. test gage reading to 300 lb., a screw testing pump, a hand puller for removing needles, a hand set for replacing needles, pliers and screw driver. The weight of the entire apparatus with the velvet lined morocco case in which it is contained is 6 lb.

All parts of the outfit including the reinforcement

AMERICAN INSPECTOR'S OUTFIT NO. 2

and trimmings of the case are heavily nickeled and are made for long and substantial service.

The outfit is manufactured and for sale by the American Steam Gauge and Valve Mfg. Co., of Boston, Mass.

IN A RECENT ISSUE of "Graphite," W. H. Wakeman recommends the use of graphite and oil for the prevention of corrosion of steam machinery. Where the machinery is to stand but a short time he recommends the use of Dixon's oil graphite No. 637 on rods, and of a mixture of cylinder oil and special graphite No. 635 on the interior cylinder surface and heads. The parts of sectional packing should be covered heavily with cylinder oil and the gaskets, if any are used, coated with graphite on one side to prevent the joints sticking together. Valves and seats should also be coated with graphite and cylinder oil.

THE COLLIN PRESSURE REGULATING VALVE

Many and varied are the forms taken by pressure regulating valves, the object of each variation being to overcome difficulties or objections, which as time goes on are developed in daily power plant practise where such valves are installed.

The Collin pressure regulating valve shown in the accompanying illustrations, is made by the Ohio Brass Co., of Mansfield, Ohio, and has several special features to which attention is called, namely, the absence of springs for opening and closing the main valve and dashpots for cushioning; the valve cushions inherently

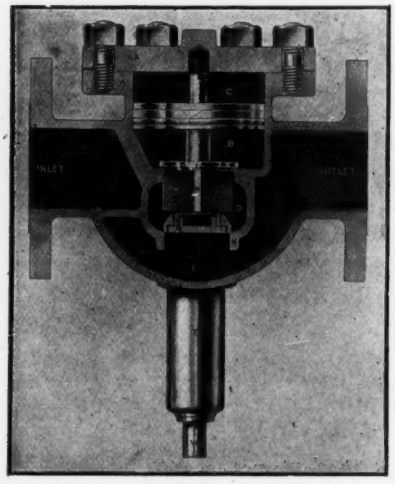


FIG. 1. SECTION THROUGH COLLIN VALVE

when closing and is balanced when open, its operation depending on the pressure of the fluid passing through it. Another point is, that the auxiliary valve, which controls the main valve, is out of the path of initial steam and never catches scale or chips.

It is interesting to trace the operation of the valve, which is clearly shown in the two sectional views. Steam enters the valve chamber B, but is divided by the splitter I, Fig. 1, in such a way as to divert it from impacting with full velocity against the valve and stem, thus distributing its force equally and enhancing the balancing properties. The steam enters the chamber C through a small hole drilled in the main piston K.

The spring case T, Fig. 2, carries the regulating spring U, which forces the Diaphragm S upward against the pressure of the outlet side of the valve. The controlling-valve chamber F, connects with the main-valve chamber C, through the drilled regulating port H. This chamber contains the controlling-valve G, which is held to its seat O by the pressure and by the spring P. At the lower end the controlling-valve is also in contact with the diaphragm S, as shown.

As soon as the pressure in the outlet or service side begins to drop, the spring U forces the controlling-valve from its seat O, allowing the steam in the chamber C to pass through the regulating port H to the controlling-valve chamber F and the outlet E. The pressure in the chamber C is therefore reduced below that in the chamber B, and the main valve rises and permits steam to pass to the service side. When the pressure on that side has been restored the diaphragm S forces back the regulating spring U and allows the controlling-valve G to seat. As soon as this occurs, the pressure in the chamber C builds up and the main valve J starts to close.

Below the main valve J, guide wings M extend through the cushion chamber D and carry a supplementary piston L, which enters the port N when the valve is closed. When the main valve J opens, it lifts beyond a point where steam cutting can occur before the supplementary piston L opens its port N. This is to prevent the cutting of the main valve and seat. In closing, the supplementary piston L enters the port N, checking the flow of steam and allowing the main valve J to come to its seat against a steam cushion formed by high-pressure steam in the chamber D.

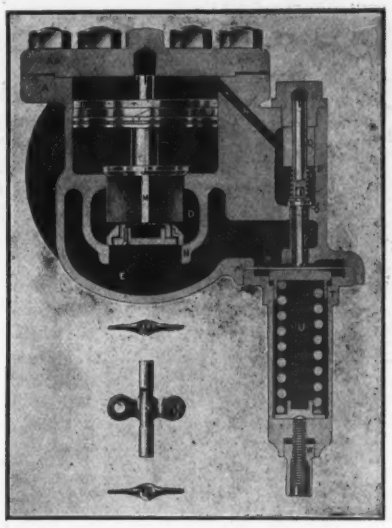


FIG. 2. SECTION SHOWING DIAPHRAGM AND PILOT VALVES

The regulating spring U is adjusted by turning the screw V by means of the end X^1 of the key X, and the adjusting screw is then secured by tightening the lock shield W, which is provided with the differential thread, using the end X^2 of the key for the purpose. A wooden handwheel and a lock-nut can be furnished, if desired, in place of the key and lock shield.

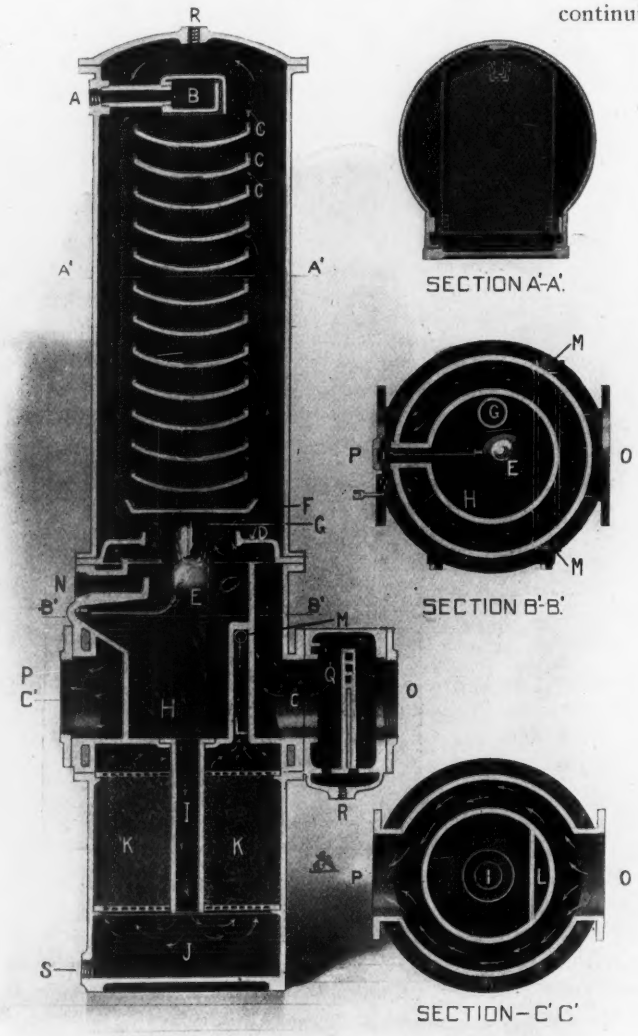
By removing the cover A A the main piston valve can be taken out as one unit; by removing the plug R the controlling-valve can be removed, and by removing the spring case T the diaphragm can be taken out. It is not necessary to remove the diaphragm in order to clean or grind the controlling-valve, but the compression must be released from the regulating spring U. The diaphragm may be removed without cutting off the inlet pressure, and this forms a convenient way to determine whether the valve is tight after grinding.

ERIE CITY OPEN FEED WATER HEATER

The Erie City Iron Works, Erie, Pa., has just put upon the market an entirely new design of open feed-water heater which is the outcome of a careful and exhaustive study of the subject. Especial attention has been given to the design of an inlet head and trays, and a deflecting plate has been introduced in order that water that may come in contact with the side of the heater shall not pass out through the overflow. Careful attention has been given to the design of the inlet valve, as much of the success of the heater depends upon having an inlet valve that is right in every respect. The oil separator has been submitted to thorough and severe tests and has proved to be very efficient.

A reheating chamber is employed from which the water is taken to the boilers, which chamber is directly opposite and in direct contact with the incoming exhaust steam as it enters the heater on one side, and with the water before it goes into the filtering chamber on the other side. By this device the water is raised from 6 to 12 deg. in temperature above that in the filtering chamber before leaving the heater. The feed water enters through the inlet pipe A and inlet head B, from which it overflows to the first scale pan C. These scale pans are shallow and have rounded bottoms. The water overflowing follows the lower part of the pan to its center and drips to the pan below, continuing this operation until it reaches the catch basin, F, at the bottom of the heating chamber. From here the water is conducted through the pipe G to the receiving chamber H, thence through the pipe I to the settling chamber J, and up through the filtering compartment K to the reheating chamber L, from which it is drawn through the feed outlet M to the pump.

Exhaust steam enters at the steam inlet O, passes through oil separator Q, around the receiving chamber to the steam outlet P. What steam is used for heating



SECTIONS OF THE ERIE CITY OPEN FEED-WATER HEATER

THE CLARK CLEANER FOR HORIZONTAL BOILER TUBES

the water in the upper chamber is drawn up by induction from the main current of the steam. Sludge is drawn off through the drain, S, from the settling chamber and separated oil and entrained water from the steam through the drip pipe, R.

PLANING BOILER TUBES

Professor Kent has stated that 1/32 in. of scale wastes 15 per cent of coal; ⅛ in., 30 per cent and ¼ in., 70 per cent. It is important then, to get rid of scale? And how is it to be done?

The Clark cleaner offers a new solution to the problem. This device has 4 blades of steel held at one end in a socket by a pin so that they can be easily removed and ground, which may be necessary once a year. At the other end the blades have round chisel edges which are held out by springs so that they act like a plane to remove all accumulations from the tubes.

The handle is made up of 3 ½-in. round bars linked together. To use the cleaner, it is simply pushed through the tube until the rider, which is behind the blade socket drops out of the far end of the tube; then pulled back, turned slightly and pushed through again. Any local thickening or hardening of scale is taken off by planing over several times at that point.

The Fred Clark Boiler Cleaning Co., 93 Nassau St., New York, which manufactures this device, also has a style for vertical boilers which can be used without interrupting the fires or letting down steam pressure.

A NEW DIE STOCK

The Oster Manufacturing Co., of Cleveland, Ohio, has added another to the many Oster valuable tools for threading pipe. This is a die stock for pipe from 1 to 2-in. the dies of which automatically recede to make standard taper thread; they are controlled by a cam, which, following the lead screw, is driven by a guide post at exact taper for pipe thread. Standard size is

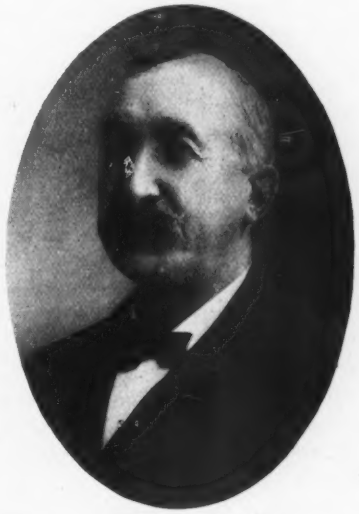
OSTER AUTOMATIC PIPE DIE

obtained by setting the guide post in position to indicate the size as graduated on the face plate, locking solid by the nut at the bottom of the post. This setting remains unaltered as long as duplicate threads are desired. Over or under size threads, or crooked threads, can be obtained. One set of dies may be used for all sizes or a set for each size, as the operator prefers.

An exclusive feature is the Universal Gripping Chuck which adjusts to all sizes by revolving a handle; this takes the place of all bushings and makes the stock entirely complete within itself, without loose parts. The gripping jaws are of tool steel hardened and will withstand the strain and wear.

GEORGE M. DAVIS

While attending to business in Merrill, Tex., Geo. M. Davis was stricken with paralysis and died very suddenly at that place on Nov. 14. Mr. Davis has been before the public for many years as a prominent inventor and manufacturer. He was born in 1844 at Eaton, New York, where he spent his early manhood as an employe in the engine works of Wood, Tabor &



GEORGE M. DAVIS

Morse. Later he entered the gun works of the Remington Arms Co. at Ilion, N. Y., where he learned the machinist trade.

In 1865 Mr. Davis came to Chicago where he was engaged in a number of busines senterprises until 1875 when he founded the G. M. Davis & Co. manufacturing firm which was later incorporaed under the firm name of G. M. Davis Regulator Co. Up to the time of his death Mr. Davis was president of this company though for the past 8 yr. he has not been actively engaged in the work. The following appliances which are well known to the mechanical world were invented and patented by him; Davis Old Reliable Air Valve, Davis Pressure Reducing Valve, Davis Noiseless Back Pressure Valve, Davis Continuous Discharge Steam Trap, Davis Damper Regulator, Davis Regulator Valve and Davis Victor Automatic Air Valve.

Mr. Davis' residence was at Austin, Ill., and he is survived by his widow and 2 sons, G. C. and W. E. Davis. His work in the company will be carried on by its manager G. C. Davis.

ANSWERS TO OCTOBER EXAMINATION QUESTIONS

1. If the boiler can be laid off for cleaning, burn out the fires under it, holding ½ glass of water meantime. When fire is out, raise water to top of glass, using hot water; and close all steam and water connections except steam gage and water column. Close the damper, fire and ash pit doors and allow boiler to cool gradually. When cooled to zero pressure, remove manhole plate and allow water to run out of the blowoff. V.

If the boiler must be cleaned quickly,—which is not good practise,—work the pressure down to 20 lb., burning out the fire at the same time. New hand hole and manhole gaskets should be provided in case of need.

Blow down the boiler slowly, and when empty, take off manhole and hand hole plates, open all doors, and allow boiler to cool as much as possible before washing. Wash with hot water.

2. Using a tubular boiler, 12 sq. ft. of heating surface are needed per horsepower. The shell has $3.1416\times6\times16\div2=150.8$ sq. ft. The back head has $6^2\times0.7854=28.27$ sq. ft. or a total of 105.7 sq. ft. if one head and half the shell be counted.

$12\times120=1440$ sq. ft. needed, and 1440—106=1334 sq. ft. to be furnished by the tubes. A 3.5-in. tube has 1 sq. ft. of surface for 1.018 ft. of length, and a 16-ft. tube would have $16\div1.018=15.7$ sq. ft. surface. $1334\div15.7=85$ tubes needed. With a ratio of heating surface to grate surface 35 to 1, the grate would be $1440\div35=41$ sq. ft. Allowing 1 sq. in. of safety valve to 3 sq. ft. of grate gives $41\div3=13.67$ sq. in., which would take a 4.5-in. valve. The spring loaded pop safety valve should be used.

3. The required size of low pressure cylinder for a given high pressure depends upon the number of times the steam is to be expanded, the initial steam pressure and the nature of the work of the engine. For steady loads the difference in size of the two cylinders may be greater than when the load is constantly changing between wide limits. F.

The ratio of cylinders for non-condensing engines with 150 lb. initial pressure is generally 3 to 1, and for condensing engines 4 to 1.

Cylinder ratio being 3, and length of stroke the same for both, the diameter of the low pressure cylinder will be 1.75 (= sq. root of 3) times that of the high pressure cylinder.

$20\times1.75=35$ in. diameter of low pressure cylinder.

4. The heat saved would be 100—45=55 B. t. u. on each pound of water.

Assuming that 1 lb. of coal will evaporate 10 lb. of water, 12,000 lb. of coal will evaporate 120,000 lb. of water. If we save 55 B. t u. per pound of water, on 120,000 lb. of water we will save $120,000\times55=6,600,000$ B. t. u. If our coal has 13,500 B. t. u., then 12,000 lb. will have $13,500\times12,000=162,000,000$ B. t. u. Subtracting the heat units saved, we have 162,000,000—6,600,000= 155,400,000 B. t. u. or 11,511 lb. of coal. F.

5. At 100 per cent efficiency, multiply pressure by half the diameter and by the factor of safety and divide by the tensile strength. $140\times(48\div2)\times6\div60,000=0.336$ in., thickness of plate =nearly ⅜ in. V.

6. Area of shell=$3.1416\times4\times18=226.2$. Area 2 heads=$2\times4^2\times.7854=25.1$. Total area is the sum= 251.3 sq. ft. Thickness=$1.038\div12=0.0865$ ft. Volume of steel=$251.3\times0.0865=21.74$ cu. ft. Weight of 1 cu. ft.=489.6 lb. Total weight=$489.6\times21.74=$ 10,643,9 lb. F.

7. To find the volume of the tank: Square the diameter of each base; multiply the 2 diameters together; add these 3 products and multiply the sum by 0.2618 times the depth of the tank; then 0.2618×15 $(144+225+180)=2155.9$ cu. ft. $2155.9\times62.5=134,743.8$ lb. water in the tank.

Raising 1 lb. water from 100 to 212 deg., takes 212 —100=112 B. t. u.; evaporating at 212 deg. takes 967 B. t. u. or the total per pound=$112+967=1079$ B. t. u.

Then $13,500\div1079=12.51$ lb. water evaporated per pound of coal and $134,743.8\div12.51=10,770$ lb. coal needed. V.

8. If the question to be solved is merely to get the feed-water into the boiler, I would use an injector. For with the temperature of feed-water at 42 deg. F., no trouble will be experienced in handling the water, and with this temperature and lift not too high it will be more economical in steam consumption than a feed pump. F.

9. Crucible steel transmission or haulage ropes, 7 wires to the strand, hemp center, breaking strain, 24 tons of 2000 lb.

Crucible steel hoisting ropes, 19 wires to the strand, hemp center, breaking strain, 26 tons of 2000 lb. F.

10. Lodge contains 1657.5 cu. ft. water. With piston velocity 100 ft, per minute, to find approximately the amount of water elevated in that time: Square the diameter of the water cylinder in inches and multiply by 4.

$4^2\times4=64$ gal. per minute=8.55 cu. ft. per minute.

Therefore $1657.5\div8.55=193.86$ minutes or 3.231 hr.

Or $12.5664\times12\times100\div231=65.28$ gal. per minute. =8.72 cu. ft. per minute.

Therefore $1657.5\div8.72=3.17$ hr.

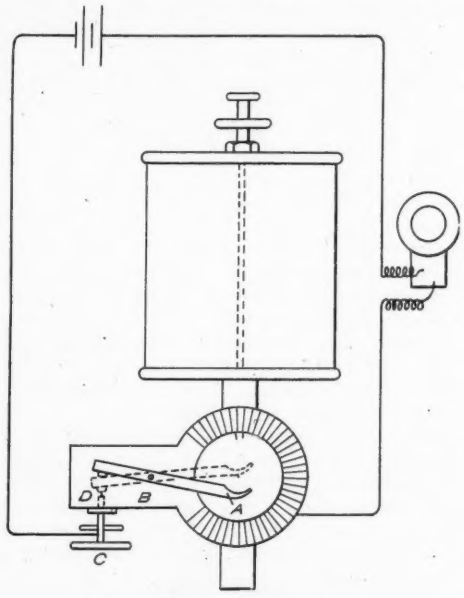
OIL FEED SIGNAL

This device, which is in successful operation at the Murphy Chair Co., Detroit, is the patented invention of E. J. Rose of that city, and has proved itself absolutely reliable and a great help to engineers whose other duties call their attention away from the bearings. Its operation has been found as sure as that of any safety device used about the power plant.

This signal can be put on any kind of an engine where the bearings are lubricated by the flow of oil. It will work on the slowest speed with or without oil cups, and can be put in anywhere between the supply

and the bearing. Mr. Rose has found by 30 years' observation and experience that 90 per cent of the shut downs are caused by the stoppage of oil from some cause and the hot bearings which result. Of course, these shutdowns result in great loss, both from the injury to the bearings and from the loss of time in the mill.

The operation of the device is readily seen from the cut. As shown, it screws into the hole for the



THE ROSE OIL FEED ALARM

lubricator in the bearing and the oil feeds down over a cup-shaped pan from which it drops to the feed pipe below. This pan is held in the off position by the weight of the oil dripping on the pan. When the oil stops feeding, the pan rises, allowing the back end of the arm to drop and closing the bell circuit. It does not depend on the heating of the bearing for its operation, so that the alarm is given as soon as the oil stops feeding, and in this way the heating of the bearing can be avoided.

A COMPOUND FOR REPAIRING IRON AND STEEL

Thousands of dollars are spent every year replacing machinery and parts, automobile cylinders, castings, radiators, boilers, fire pots, pipes and a thousand and one other things which have become useless because of cracks, spongy spots, sand holes or blow holes.

There is hardly a factory of any size that does not contribute something to the scrap heap every year which could be saved were it possible to repair defects in iron and steel. We, therefore, believe our readers will welcome the news that this is now possible by the use of a product which the H. W. Johns-Manville Co., New York, is placing on the market under the name "Leak-No Metallic Compound."

Leak-No is a chemical compound resembling powdered iron. When mixed with water and applied like putty to defects in iron or steel articles, the manufacturers claim that it metallizes and becomes a permanent part of the article to which it is applied. In color it very much resembles iron, when hard.

The manufacturers show their faith in this material by offering to refund the purchase price in case it fails to stop any ordinary leak in anything made of iron or steel against any pressure of oil, steam, gas, air, ammonia or water; and to stand any heat or chemicals that iron will stand, when applied according to directions.

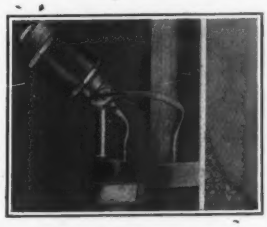
A folder which the manufacturers have issued, gives further particulars about this material.

A LUBRICATOR FOR ELEVATOR GUIDES

This lubricator will appeal to any engineer or helper, who weekly or oftener mounts upon the top of his elevators and slowly goes aloft to grease the guides. He hopes that the operator will not forget that he is above and go ahead full speed, and that the weight of a neighboring elevator will not strike him in passing. Of course, he expects to be careful, but everyone familiar with the subject knows that accidents happen in this work.

Hand greasing cannot give a perfectly even distribution on the guides, and there are bound to be spots where the elevator rubs a little, taking the grease off the guides at those spots on the first trip, so that they are left comparatively dry until the next greasing day. The Imperial lubricates the guides evenly, and upon every trip of the elevator.

The appliance consists of a compression cup in which the grease is contained, and from which 3 metal tubes carry the grease to self-adjusting distributors, which are held by spiral springs in constant contact



THE IMPERIAL ELEVATOR GUIDE LUBRICATOR

with the guides. The lubricator is fastened on the top of elevator by a device which varies to suit the make of car, no cutting or drilling of holes being necessary.

The car should be at the bottom of the shaft when the cups are filled, and the car moving up and down spreads the grease automatically, effectively, and with the greatest economy. Under the Imperial system of lubrication there is at no time an excess of grease on the guides and none on the sides of the car, on the grill work or on top of the car. It is sold by Geo. M. Newhall Engineering Co., Philadelphia, Pa.

AN OPEN LETTER TO

YOU men who subscribe to and read Practical Engineer are the ones who keep up its quality. You are the men whose constant support makes possible its regular appearance from month to month, and don't for a moment think that this fact is overlooked. In the past eight months you have all shown a good will that is especially pleasing to the editors—a cordiality which proves beyond a doubt that you place due value on Practical Engineer and that the practical nature of its contents meets your needs in every way. The hundreds of you who are and have been sending in your renewals show your feelings stronger than any words could do.

You have all noticed the forward strides made of late by Practical Engineer and we promise you that this steady, uniform improvement will continue in the future. Eight months ago Practical Engineer hit the up grade and it's now well on its way to even greater improvement and usefulness.

But long winter evenings are here. Reading and study are in order so we are addressing this letter to you in order that you shall be fully informed about the next issue and its value.

We want Practical Engineer's influence to extend even farther than at present. And it will. But first we want you whose subscriptions have just expired or are about to expire, and who have not renewed, to send in your renewals at once.

How to Make Good

You are in the engineering business to "make good" to those who employ you. Practical Engineer is in the business to "make good" to you who read it. "Make good" is the spirit that controls us all. Without it not one of us would have the courage to strive constantly to successfully accomplish what stares us in the face.

Practical Engineer more than ever before will exert its utmost energies to help practical engineers make good.

Your business as an engineer has a good many more knots and twists about it than show on the surface—more than anyone not familiar with the engine room will ever know. There's just one way to get a strangle hold on these things, and that can be summed up in two words—study and work.

We know that you're not a believer in the principle of perpetual rest, so our remarks will be confined to study and improvement.

Your knowledge is your capital—your stock in trade.

Give a man knowledge of his work and he is strong, resourceful, sure to win, and his salary (generally gaged by his ability) will be in exact ratio to what he knows. So it pays to know. It pays to try to know more and in the ever-changing field of power plant engineering it pays to read and to know that you know.

Your Best Assistant

The best assistance to greater knowledge that you can have is Practical Engineer—the paper all engineers like. We know that times have not been booming with you. We also know that many of you have been working short time and irregular hours—some of you have even been out of a job. But the wheels are beginning to turn again, new life is being felt, so we don't feel any hesitation about asking you to renew your subscription now, because—

You have something good and big a-coming. You'll have in one issue of Practical Engineer the best treatise you ever read on the subject, "Treating and Handling Feed Water."

The "Feed Water Number"

will be issued January 1, 1909. You have less than a month to wait. It will contain 100 or more pages of specially prepared text (fully illustrated) devoted to this one important subject. You of course know that fuel and water are the raw materials of power plant work. Their use represents your largest expense—their handling your greatest economy. And this number will point the way to economy in the handling of water for the generation of steam. You must not miss this number and you won't if you renew your subscription at once. It will not be sent to you whose subscriptions have expired—so look sharp and see that you get yours.

Many of you have asked about this number—and in order that you may all know all about it we here give you an outline of its value.

To begin with the Feed Water Number will be divided into three main sections, the first of which will be "Treating for Impurities," second "Heating Feed Water," third, "Feeding the Boiler."

Treating for Impurities

In the first section you will find a complete account of sources of feed and impurities found, including as the first source, rivers and reservoirs, with their impurities, such as animal, vegetable and mineral matter held in suspension—oils and acids in sewage. Then come wells with the mineral salts they hold in solution. Then returns from engines and heating coils with oil and sediment contained.

Following this text will be a treatise on "Troubles from Impurities" which will be thoroughly interesting. It will doubtless recall to your mind some tight place you have been in .

The Various Methods of Purifying Feed Water are then explained. For instance, suspended matter and its removal by means of settling, filtering, skimming and the apparatus used. Mineral salts and their removal by softening, heating, settling and through the use of boiler compounds. Here the best and most successful systems will be described and all mechanical apparatus and various materials fully explained and illustrated. Oil in returns is another difficulty you have often met and in the article telling about separating, filtering and settling to remove oil which follows, you'll get the results of the latest experience and most approved practice besides a full description of the commercial apparatus used. And this ends the first main section. What do you think of it? Sounds good, doesn't it? And it is good.

OUR SUBSCRIBERS

Heating

"Heating Feed Water" is then taken up. This second section will be introduced by an eye-opening article on the saving effected by heating feed water. Types of feed water heaters will then be discussed and the advantages of both open and closed heaters will be presented in plain practical style. To read this article means a thorough understanding of these important power plant auxiliaries. You'll understand fully the action of open heaters, straight tube, bent tube, and double flow heaters. The temperature attained by live and exhaust steam will be shown by carefully worked out tables also the surface and volume per horsepower and surface required to condense 100 pounds of steam per hour. You will readily admit how very important these facts and figures are. You can use them constantly and will have them in permanent, up-to-date, get-at-able form when the man comes down from the office and says, "Bill, figure out what new feed water equipment we need and let me have it right away." It surely does pay to be ready.

Economizers will also be included in this second section and everything you want to know about their operation and installation will be fully given and each type described.

And here ends Section Number 2.

Boiler Feeding

Then follows Section Number 3, which will embrace subjects associated with "Feeding the Boiler," and although you may be perfectly satisfied with your present method of feeding your boiler and the results you obtain, you'll find a lot of good, wholesome engineering information here that you can't get anywhere else—information that's liable to come in handy any old time.

Methods used in boiler feeding, principles involved and the commercial apparatus applied, such as pumps, injectors, return traps, and steam traps, are only a few of the good features of this section. Controlling the feed water by means of pump governors, feed water regulators and water alarms will also be included with a lot of other data on feed water connections, methods of piping, provisions needed in pipe and valves, styles of valves and methods and material for covering pipes.

You see every phase of the subject will be covered in this one number. You can't know too much about the proper heating of feed, and saving of condensed exhaust, the eliminating of scale, the reduction of repairs, cleaning and operating costs. The more you know of these subjects the better you'll be equipped to handle your own individual problems and the better record you can make. Then be sure to get your copy of the Feed Water Number. It will help you.

The price of it alone will be 50 cents, but you will get it with your regular year's subscription at the price of an ordinary issue if you don't allow your subscription to lapse. Only enough copies will be printed to send to paid subscribers, so be sure and see that your renewal is in our hands.

$1 brings you the big "Feed Water Number" and eleven other numbers for one year.

Our Big Offer

$1.50 brings you the big "Feed Water Number" and twenty-three other numbers for two years. With your two years' subscription at $1.50 we'll send you absolutely free this 6-foot Steel Pocket Tape. You can use it every working day of your life. This tape

AUTOMATIC 6-FOOT STEEL TAPE. FREE. POCKET SIZE
(CASE 1½ IN. DIAMETER)

is enclosed in a finely finished nickel case (pocket size) and is of black enamel finish, ¼-inch wide with dimensions shown in white, easily and quickly read and accurate to a hair's breadth. Operates on a central shaft in a manner similar to a window shade—locks at any point and is released and returned to the case by thumb pressure on a button. It's a mighty handy thing to have in your pocket all the time, and you can have it free with two years' subscription to Practical Engineer.

Remember, 1 year $1, and the Feed Water Number included. 2 years $1.50, and the Feed Water Number included with a Steel Tape Free.

We want you to stick for the big show. We want you to receive the Feed Water Number on January 1, 1909, and the good numbers which follow. Will you?

This offer is for every subscriber of Practical Engineer, no matter when your subscription expires, but is intended specially for you who have just received your expiration notices.

Take advantage of this splendid offer today—before it's too late, and you'll never be sorry that you did. Fill out your subscription blank—now—while you have the matter before you, and return to us with remittance this week; your subscription will be continued and your copy of the Feed Water Number will surely come. Don't over look it, and tell your friends about it.

PRACTICAL ENGINEER,
355 Dearborn St., Chicago.

NEWS NOTES

WALTER B. SNOW, Publicity Engineer, of Boston, has been appointed by Governor Guild a member of the Massachusetts Commission for the Blind.

SPITE OF THE GREAT ADVANCES in the use of cement, terra cotta, steel and other materials, wood remains the chief building material of the country. Sixty-one per cent of the building permits issued last year were for mere wood construction.

THE SARNIA TUNNEL of the Grand Trunk R. R., which is 6,032 ft. long under the St. Clair river at Port Huron, Mich., and is equipped for electric traction, was turned over to the railroad by the Westinghouse Co. on Nov. 12. The grade is 2 per cent and 2 of the locomotives can handle a 1000-ton train at 10 miles an hour.

GILLESPIE BROS. & Co., of 4 Stone St., New York, are figuring on plans for an irrigating scheme for one of the Southern republics, and those who manufacture material for such purposes will do well to get in touch with them.

EXAMINATION WILL BE HELD for junior engineer with the Geological Survey on Dec. 2 and 3, the subjects covering elementary chemistry, physics and mathematics, an essay on some engineering subject, special engineering topics, including testing of materials, of fuels, mining operations and the mechanics of engineering. The applicant can choose which special engineering subject he will take for examination. The requirements are: 21 years of age, good physical condition, and citizenship in the United States. Application should be made on Form 1312 to the U. S. Civil Service Commission, Washington, D. C. Salaries range from $600 to $1200 a year, depending on the ability of the applicant.

JAMES MCCREA & Co., Chicago, manufacturer of the Climax Steam Joint Clamp and other pipe repairs, has brought suit for infringement against the Simplex Engineering Co., of Philadelphia, which has recently placed a pipe joint clamp on the market.

THE NERNST LAMP CO. has received a contract from the Rosenbaum Company, proprietors of one of the largest department stores in Pittsburg, for an installation of 3-glower Westinghouse-Nernst lamps, replacing the 6-glower Nernst lamps which have been in use for the past four years.

The contract was a result of comparative tests made in different departments of the store with Westinghouse-Nernst and Tungsten units.

WESTINGHOUSE ELECTRIC AND MFG. CO. has been awarded a contract of $5,000,000 for electrification work on the New York Terminal of the Pennsylvania Lines.

KEUFFEL & ESSER CO. has opened a new branch house in Montreal, Canada, at 252 Notre Dame St. West, where will be carried a complete line of drawing materials, mathematical and surveying instruments, measuring tapes, etc. The company will also do blueprinting at this branch office for the trade. The building is a 4-story modern office and store structure and will be under competent management suitable to maintain the leading position which this firm has in its line.

AN EXPOSITION OF GAS APPLIANCES will be held by the National Commercial Gas Association in the First Regiment Armory, Chicago, Dec. 7-12. The exhibit will include appliances for utilizing gas in industrial work, in the home, in gas engines, and for special purposes. Full information can be had from J. C. D. Clark, 157 Michigan Ave., Chicago.

A NEW METAL called Monel metal, which is an alloy of nickel and copper, has been found specially suitable for use with high-pressure steam, superheated steam, salt water, acid water and bad mine waters. It is made in 3 grades with tensile strengths of 85,000, 65,000 and 70,000 lb. per square inch.

THE STATE OF OKLAHOMA has a license law which went into force on July 16. The questions asked in the examination covered: What is an engineer required to do under the new state law? What is meant by the horsepower of an engine and what is a horsepower? What is the relation between the breaking strength and safe working strain on a rope? Explain the action of an injector. What is the method of finding the area of safety valves for a boiler? What would you do in case a hoisting rope broke? What is a heat unit? Name some of the safety appliances for boilers. How is the horsepower of a boiler calculated? Name seven of the most essential parts of an engine. What are the hoisting signals? What are your habits in regard to intoxicating liquors?

The next meeting of the board of examiners will be held on Jan. 5, 1909. The examination was largely for hoisting engineers.

DEC. 1 TO 4 WILL BE the winter meeting of the American Society of Mechanical Engineers at 29 W. 39th St., New York City. Tuesday evening will be given up to the president's address and a reception. Wednesday forenoon will be occupied with a business meeting and papers on The Engineer and The People by Morris L. Cooke and on aeronautics by Maj. G. O. Squier. Wednesday afternoon will be taken up the subject of steam and power plants, papers being read by A. R. Dodge on Obtaining Ratios of Specific Heat of Vapors, by Dr. Harvey N. Davis on The Total Heat or Saturated Steam, by C. R. Weymouth on Fuel Economy Tests and on An Automatic System for Firing Oil. In the evening a lecture will be given by Lieut. Frank P. Lahm on Aeronautics. Thursday morning will be devoted to machine shop practise, including papers on Milling Machine and Cutters by A. L. DeLeeuw, Metal Cutting Tools by James Hartness, Interchangeable Gear Tooth Systems by R. E. Flanders, Durability of Gears in Railway Service by S. A. Hand. At the afternoon meeting the papers will be on miscellaneous topics; Compound Locomotives by C. J. Mellin, Liquid Tachometers by Amasa Trowbridge, Training Workmen by H. L. Gantt, Averaging Instrument for Polar Diagrams by Prof. W. F. Durand, Salt Manufacture by Geo. B. Willcox. During this afternoon a session of the Gas Power Section will also be held and papers read by L. H. Nash on Reminiscences of a Gas Engine Designer and by F. C. Wagner on Possibilities of the Gasolene Turbine. An evening dancing reception will be held in the Society Building on Thursday evening. Friday morning the closing session will take up papers on experimental data, Economic Storage and Transportation of Carbonic Acid by Prof. R. T. Stewart, Slipping Point of Rolled Boiler Tube Joints by O. P. Hood and G. L. Christensen, Friction Clutches for Power Transmission by Prof. R. G. Dukes.

RICHARD THOMPSON, formerly of the firm of Richard Thompson & Co., has become associated with L. J. Wing Mfg. Co., of New York, and will continue the manufacture, sale and installing of steam specialities, such as indicators, planimeters, damper regulators, grate bars, tube cleaners, etc., in connection with Wing's Turbine Blower system of mechanical draft.

CATALOG NOTES

NATIONAL SEPARATOR & MACHINE CO., of Boston, has a combined oil separator and filter for separating the oil from metal chips, waste, etc., at

the same time running it through a filter to remove fine particles.

DODGE MFG. CO. of Mishawaka, Ind., shows in a graphic manner on a folder recently received the advantages of purifying feed water by the Eureka process and machine.

AMERICAN SPIRAL PIPE WORKS in a new edition of its catalog describing Spiral Riveted Pipe, Forged Steel Pipe Connections, Exhaust Steam and Hydraulic Supplies, shows the construction of the Taylor spiral riveted pipe, gives interesting views of a large number of installations of long water supply lines and exhaust steam piping and of spiral riveted pipe used for brine circulation. An interesting feature of the catalog is the blue print profile sheets of pipe lines and the details of sheet steel fittings and of forged steel flanges. It is a handsome and interesting book.

E. G. T. COLLES & CO., of Chicago, Ill., has recently published a catalog describing its feed-water heaters, purifiers and steam specialties. The book is neat in appearance and made attractive with numerous halftones and other illustrations.

ELECTRICAL RECORDING INSTRUMENTS, including ammeters, voltmeters and wattmeters for alternating and continuous current, are described in a catalog issued by John Bliss & Co., 128 Front St., New York. These are the Elliott instruments, made by Elliott Brothers, of London, England.

JONES STOKER INSTALLATIONS as used in electric stations and industrial plants are impressively shown in a booklet sent out by the Underfeed Stoker Co. of America, which includes views of Jones Stoker installations in plants from New Hampshire to Nebraska, and from Milwaukee to Memphis. Repeat orders figure prominently in the list. A copy of the booklet is free on request.

BOILERS OF MERIT are made by the Kingsford Foundry and Machine Works of Oswego, N. Y., and are described in a booklet of that title which shows details and dimensions. There are several novel features. A copy is sent on request.

ANOTHER OF THE Stephenson girls has just visited the office. She was a mighty nice girl, too,—very quiet and demure, and will pay you a call if you drop a postal to the Stephenson Mfg. Co., Albany, N. Y.

WHAT RADIATION OF HEAT MEANS TO YOU is the title of a booklet sent out by H. W. Johns-Manville Co., of New York City, in which is shown the saving in coal consumption by the use of a good insulating covering on pipe lines for steam and hot water. A new feature in the Johns-Manville Product is the sectional conduit for covering underground pipes which convey steam, gas, water or other liquid.

NORTHERN SELF CLOSING SAFETY WATER GAUGES have their advantages as described in a folder recently received from the Northern Specialty Co., of Utica, N. Y.

MARCO PACKINGS, made by the Cleveland Rubber Works, have a good many unique features, all of which are fully described in the new 1909 catalog which we have just received. This catalog is unique in that it tells a lot of things about where to use what kind of packings and how to put them in and take them out, as well as telling all about the qualities of the different brands of Marco Packings for all kinds of uses. Running through the catalog, besides packing information, is a series of notes on engineering subjects, kinks for the engine room and tables of values that will be found helpful. Besides being interesting and useful, the book is handsome.

SCARCELY MORE THAN 6 monhs after the publication of the large first edition of its catalogue, entitled The Swartwout Cast Iron Exhaust Head and Centrifugal Steam Separators, The Ohio Blower Co., of Cleveland, Ohio, was obliged to go to press with a second edition equal in size to the first. The cause is not far to seek, for this catalogue has been frequently referred to as "the finest in the steam specialty field." It is now ready for distribution to those who were unable to obtain copies of the first edition.

ALLIS-CHALMERS WORKS AND PRODUCTS are fittingly represented by the text and illustrations of an interesting and attractive booklet just received from the company whose name it bears. The illuminative general views in yellow and detail machines and plants in black make a pleasing contrast and artistic finish.

TRADE NOTES

THE PHILADELPHIA ELECTRIC COMPANY, Philadelphia, Pa., has placed an order with the Reagan Grate Bar Co., of Philadelphia, to equip all the boilers of its arc-light station, 2800 hp., with Regan grates.

THE CONNECTICUT CO., New Haven, Conn., has given an order to the Reagan Grate Bar Co., Philadelphia, Pa., to equip the entire Station A Plant at New Haven, Conn., with Reagan grates.

THE PLANT OF THE Kingsford Foundry & Machine Works, Oswego, N. Y. has operated full time during the past year on Internally Fired and Marine boilers. The company reports that from present indications it will have a very busy winter, as many inquiries are received and during the past week orders for 5 marine boilers have been placed.

RECENT SALES reported by the York Mfg. Co., York, Pa., are, to: Jacob Ruppert Brewery, New York, 1 500-ton vertical, single-acting machine with cross-compound, condensing engines and complete compression side. Three pairs of 21 by 34-in. York vertical single-acting compressors replacing 16 by 34-in. De La Vergne double-acting. White Mountain Creamery Co., New Bremen, Ohio, 1 10-ton compression side, single-acting, 2-ton ice making plant and piping for storage rooms. Frank W. Hoffman, Baltimore, Md., 1 5-ton compression side, vertical single-acting and piping for storage room. Montreal Engineering Co., Montreal, Canada, 1 complete 25-ton ice making plant. Canadian Kodak Co., Toronto, Canada, 1 65-ton compression side, vertical single-acting. John Kloss, Wheeling, W. Va., 1 10-ton compression side, vertical single-acting, 2-ton ice plant and piping for storage rooms. Moore & Quinn, Syracuse, N. Y., 1 30-ton compression side, vertical isngle-acting. Elkins Brewing Co., Elkins, W. Va., 15-ton freezing system complete. General Chemical Co., Easton, Pa., 1 6-ton compression side, vertical single-acting. Masonic Temple, New York, 1 10-ton compression side, horizontal double-acting, drinking water cooling system and piping for refrigerators. Homeopathic Hospital, Pittsburg, Pa., 1 30-ton compression side, vertical single-acting, 4-ton ice making plant and piping for storage rooms. P. C. Schuller, Johnstown, Pa., 1 10-ton

compression side, vertical single-acting, 2-ton ice plant and piping for storage rooms. J. J. Wallace, Elkins, W. Va., 1 10-ton compression side, vertical, single-acting, 2-ton ice plant and piping for storage room. N. T. Wax, Amory, Miss., 1 10-ton compression side, horizontal double-acting, and 5-ton ice making plant. Kodak, Limited, London, England, 1 65-ton compression side, vertical single-acting. Atlantic Hygienic Ice Co., Brooklyn, N. Y., 2 175-ton compression side, vertical single-acting and 1 complete 150-ton ice making plant. John S. Bush, New York, 1 20-ton compression side, vertical single-acting.

G. C. ST. JOHN, 90 West St., New York, has recently sold and shipped one of his large size St. John Air Meters to the Consolidated Gold Fields, Durban, Natal, So. Africa, to be used in connection with a prize test the government there is conducting on rock drills.

THE POWER PLANT SPECIALTY CO., of Chicago, designers and manufacturers of the Vater Hot Process of water softening apparatus recently moved its offices from 245 S. Jefferson St., to more convenient quarters in the Monadnock Block, room 625.

ENGINEERS, WHETHER FROM MISSOURI or elsewhere, will be interested in the experience of F. W. Lehrack, a prominent mill and elevator builder of Kansas City, with Albany Grease at the Milwaukee Elevator. Mr. Lehrack writes Messrs, Adam Cook's Sons, New York City, the sole makers of this well-known lubricant, as follows:

"We like it the best of any grease we have ever used. Last year at this time our elevator required seven hundred pounds of ice per day to keep hot boxes "down;" this year, we are using Albany Grease and no ice. I have destroyed all the ice boxes for good.

The old saying "Grease is cheaper than machinery" certainly holds good with us at the Milwaukee. Our boxes are getting in better shape right along."

Facts such as the above go a long way to convince one that Albany Grease is indeed the ideal remedy for all lubrication troubles

BULLETIN 4616 recently issued by The General Electric Co., contains a detailed description of the high voltage Type H transformer, which is used in connection with long-distance transmission lines and is designed for indoor operation. It is oil insulated, self-cooled, and the larger sizes of this transformer are water cooled. It is made in sizes up to approximately 350 kw. capacity for operation on circuits of the highest commercial voltage.

ONE OF THE HANDSOMEST SOUVENIRS which was distributed at the Denver convention was that of the Pilley Packing and Flue Brush Mfg. Co. of St. Louis, Mo. A few were left over, and as a special favor to Practical Engineer readers the company has agreed to send one of these free as long as they last to each engineer who requests it and gives the name of the firm which employs him.

WANTED

"Positions Wanted" advertisements not exceeding 50 words for subscribers to Practical Engineer will be inserted twice free of charge. "Help Wanted" and special advertisements 25 cents a line.

FOR ENGINEERS

The new revised edition of the Modern Engineer's Hand Book. A $2.50 Book by mail on receipt of 50 cents. Be quick. Address, W. H. Ermentrout, 514 Elm Street, Reading, Pa. 4 tf

FOR SALE

60 steel storage tanks, 6,000 gallons' capacity. Good as new. Double riveted, extra well built. Suitable for storage of oils, waters or liquids of any kind. 100 steam pumps. Get our prices on engines, boilers and electrical machinery. All sizes and kinds. Chicago House Wrecking Co., 35th and Iron Sts., Chicago. 4 tf

ENGINEERS AND MECHANICS

To make big money selling Incomparable "ZIZ" Hand Soap. A 10-cent can will instantly remove more dirt and stains from the hands than four cakes of any soap made, and it will not injure the most delicate skin. Small sample free. Byram Mfg. Co., Box 3133, Boston, Mass. 4-1

PATENTS

C. L. Parker, Late Examiner, U. S. Patent office, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. 186 McGill Building, Washington, D. C. 4 tf

PATENTS

Watson E. Coleman, Patent Attorney, Washington, D. C. Advice and books free. Highest references. Best services. 4 tf

SALESMAN

We want a good Salesman in every city in the United States, to handle Ideal Metallic Packing. Manufacturers' Agents and Engineers preferred—Ideal Metallic Packing Co., South Stillwater, Minn. 4 tf

SALESMEN WANTED

To introduce our New Commercial and Statistical State Chart for office and general use. The work is congenial and profitable, the earnings being according to your ability. A thorough training is given before the work is started. Rand, McNally & Co., Chicago, Ill. 10-5

POSITION

By Chief Engineer, seventeen years' experience in power plants, A. C. and D. C. machines, compound and Corliss condensing engines. Also have practical business education. Address L. J. R., 218 Pennsylvania Ave., Elmyra, N. Y. 11-2

POSITION

First-class engineer wants position in or near Nevada or South Dakota. Fifteen years' experience as assistant and chief. Graduate of technical school. Experienced with steam, electric and refrigerating machinery, and with pumps. Strictly sober and steady. Thirty-eight years old. Very best references. Address J. V. Kilkin, 207 Prospect Ave., Syracuse, N. Y. 11-2

POSITION

Want a place as stationary engineer, either in factory or electric light plant. Nine years' experience. Can give references or come on trial. Address L. R. Smith, Box 433, Fairbury, Ill. 11-2

POSITION

As chief engineer, experienced with all kinds of engines, A. C. and D. C. generators, motors and switch boards, boilers and pumps and all apparatus connected with a plant. I can get results and furnish best of references. Now employed, but want to change. Address Box 89, Practical Engineer. 11-2

POSITION

By diamond drill operator, three years experience. Can set bits. Eight years in charge of engines and boilers. Would work in plant until vacancy in field. Address Box 90, care Practical Engineer. 11-2

POSITION

By electrician with twelve years experience with all makes of motors, generators, arc lamps and meters, rebuilding city light and power plant inside and outside. Prefer assistant superintendent of small light and power plant. Am a business getter for commercial lighting. Best or references. Address Otto Von Humrick, 310 Gibson St., Detroit, Mich. 11-2

POSITION

By engineer with 15 years' experience in manufacturing and power plants. At present chief of large manufacturing concern's power plant. Will be at liberty December 1st and desire a position in Pacific Coast States. Address Box 88, care of Practical Engineer. 10-2

POSITION

As chief engineer or assistant. Age 32. Holding chief engineer's marine license, and also stationary license. Have had eight years' experience, four years in electric light and power station. Address L. W., Ossining, N. Y. 10-2